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Atlas of North American Astragalus

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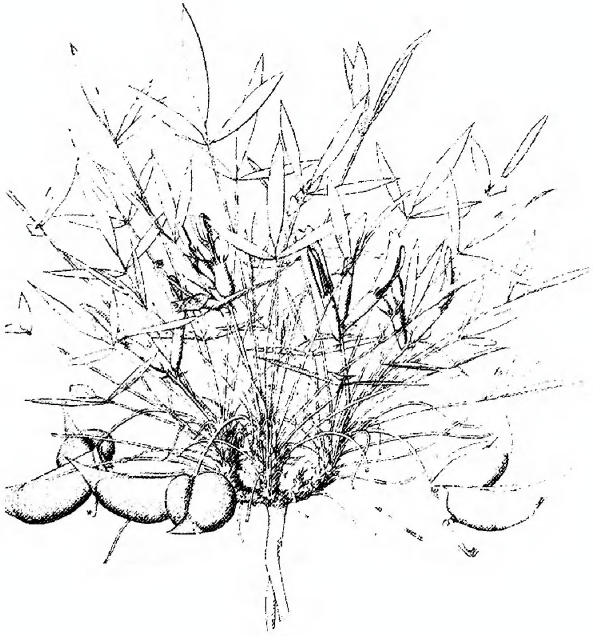
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Atlas of North American Astragalus



Astragalus musiniensis

Memoirs of The New York Botanical Garden Vol. 13

ATLAS
of
NORTH AMERICAN
ASTRAGALUS

Part II

THE CERCIDOTHRIX, HYPOGLOTTIS, PIPTOLOBOID,
TRIMENIAEUS and OROPHACA ASTRAGALI

by

RUPERT C. BARNEBY

1964

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Vol. 13

PART 2

1964

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The CERCIDOTHRIX ASTRAGALI

LIII. Sectio ULIGINOSI

Caulescent perennials, the stems arising singly or few together from buds on oblique root-stocks or creeping rhizomes; *pubescence* dolabriform; *stipules* connate; *leaves* imparipinnate, with 9-35 leaflets; *racemes* densely many-flowered, the flowers of moderate size, at full anthesis nodding and retrorsely imbricated, the banner $\pm$ 11.5-19 mm. long; *pedicels* persistent; *calyx-tube* campanulate or sub-cylindric, strongly oblique or dorsally gibbous at base; *petals* ochroleucous or tinged with lurid purple, regularly graduated, the banner recurved through 40-90°, the keel-tip obtuse; *pod* erect, sessile, firmly attached to the receptacle, oblong-ellipsoid or -cylindroid, straight or incurved, terete or sulcate dorsally, leathery or subligneous, fully bilocular; *dehiscence* apical, tardy, through the short-triangular, long-cuspidate beak; *ovules* 16-28.—Spp. about 4, mesophytes or (*A. oreganus*) xerophytes, 2 of eastern Asia, 2 of North America, of which *A. canadensis* is polymorphic and dispersed over a great part of United States and southern Canada.

ASTRAGALUS sect. ULIGINOSI Gray in Proc. Amer. Acad. 6: 196. 1864.—Sp. typica: *A. uliginosus* L.—A. sect. *Uliginosus* Sheld. in Minn. Bot. Stud. 1: 166. 1891, nomen.

Astragalus subgen. *Cercidothrix* sect. *Euodmus* Bge., Astrag. Geront. 1: 96. 1898, pro parte.—Sp. lectotypica: *A. uliginosus* L.

Astragalus sect. *Euodmus* ser. *Erectostricti* Gontsch. in Fl. U. R. S. S. 12: 435. 1946.—Sp. lectotypica: *A. uliginosus* L.

The section *Uliginosi* was designed by Gray to accommodate the American *A. canadensis* and *A. Mortonii* together with the Siberian *A. uliginosus*, and as such, even granted the additions of *A. kamtschaticus* (Kom.) Gontsch., *A. Schelichovii* Turcz. (both of eastern Asia), and the specialized *A. oreganus* of the high Wyoming deserts, it is an obviously natural group easily defined by the common characters of rhizomatous root-stock, dolabriform vesture, and nodding flowers of characteristic shape and proportions, which are succeeded by erect, persistent fruits either terete or with rounded sides and a dorsal sulcus. The comparable but more comprehensive sect. *Euodmus*, proposed a few years later by Bunge, contained not only *A. uliginosus* here selected as sectional typus, and *A. Schelichovii*, but also *A. peduncularis* Royle of the Himalayan region and *A. odoratus* Lamk. of the Caucasus and Turkey, which differ in their reflexed fruits. They have been set apart by Gontscharov (1946, p. 438) as a ser. *Nutantes* in sect. *Euodmus* but are probably best treated as forming a separate section. Their disposition lies outside the scope of this volume. One other species is pertinent to the discussion of sect. *Uliginosi*, *A. falcatus* Lamk., native to Europe and western Asia and sparingly naturalized in western United States. This also has been included, by Bunge and by Gontscharov, in sect. *Euodmus*, where it formed for the latter a monotypical ser. *Falcati* (op. cit., p. 442). Like the *Nutantes*, it has an abruptly deflexed legume, but this is quite sharply trigonous; the flowers are differently proportioned, and the stems arise together from the crown of a woody taproot. The systematic position of *A. falcatus* must be determined against the background of possibly related Old World species; I feel satisfied, however, that it is not closely related to the core of sect. *Uliginosi* from which it is accordingly excluded.

The section has no really near relatives in America. The closest approach to agreement in important morphological characters is found in sect. *Onobrychoidei* (= subgen. *Cercidothrix* sect. *Onobrychium* of the Old World, where it has its center of abundance and speciation), similar to the *Uliginosi* in the hair-attachment and connate stipules but differing in the erect flowers, the triquetrous finally deciduous pod, and the determinate, never rhizomatous root-crown. The section seems isolated in the genus, and its mesophytic tendencies are suggestive of a primitive status. The species supposedly most nearly related are of the Old World, and the section is clearly an Asiatic element in the American flora, presumably an old immigrant across the Behringian land-bridge. The chromosome number ($2n = 16$) reported for two forms of *A. canadensis* is in harmony with this view.

Key to the American Species of Sect. *Uliginosi*

1. Stems tall, mostly 1.5–16 dm. long, the internodes not strikingly abbreviated upward and zigzag; plants of moist, though often summer-dry soil, widespread over the United States e. of the Sierra-Cascade axis and s. Canada 188. *A. canadensis*
1. Stems low, 0.6–2 dm. long, the internodes short and strongly zigzag; arid sandy knolls and talus, w. Wyoming and s. Montana, local 189. *A. oreganus*

188. *ASTRAGALUS CANADENSIS*

Usually robust, more rarely quite slender caulescent perennials, the stems arising singly and few together from oblique or horizontally spreading, at length woody rhizomes, more or less densely strigulose with straight or largely straight, appressed and subappressed, dolabriform hairs up to 0.3–0.9 (1) mm. long, the leaflets commonly glabrous but sometimes densely pubescent above, the inflorescence (especially the bracts) nearly always pilosulous with some longer, looser, basifixed hairs up to 0.5–1.1 mm. long, the herbage green or sometimes cinereous, the thin-textured, often visibly nerved leaflets usually somewhat bicolored, paler beneath than above; *stems* mostly erect, sometimes decumbent and ascending, (1) 1.5–10 dm. long, fistular when stout, green or purplish, leaflets at base, simple or branching upward; *stipules* deltoid, deltoid-acuminate, or lanceolate, 3–18 mm. long, membranous, pallid, early becoming scarious, the lower ones often fragile and deciduous by late anthesis leaving a scar or low ridge around the stem, at least the lowest ones and those of the more slender spurs or branches (often all) amplexicaul and connate into a bidentate sheath, this sometimes ruptured by expansion of the stem, the median and upper ones commonly decurrent around about half the stem's circumference, all thinly pubescent dorsally and often beset, especially at the point of insertion, with a few minute knob- or tack-shaped processes; *leaves* (3) 5–35 cm. long, shortly petioled or the upper ones subsessile, with (7) 13–35 broadly lanceolate, lance-oblong, ovate-oblong, or elliptic, rarely obcordate, obtuse and mucronulate, obtuse, or shallowly emarginate, flat leaflets (0.5) 1–4.5 (5) mm. long; *peduncles* erect or incurved-ascending, (2.5) 4–22 cm. long; *racemes* densely (in the Appalachian region sometimes rather openly) many-flowered, the mostly subcontiguous flowers ascending in bud, early spreading and then declined and nearly always retrorsely imbricated, forming an at first tapering or ovoid but at full anthesis cylindric spike 2.5–16 cm. long, 2.5–3.5 cm. in diameter, the axis little elongating, the erect fruits crowded into an oblong heads; *bracts* membranous, pallid, narrowly lance-acuminate or linear-caudate (exceptionally ovate), (1.2) 2–10 mm. long, reflexed in fruit; *pedicels* ascending or a little arched outward, at anthesis 0.5–1.7 mm., in fruit erect or ascending, straight, thickened, 1.2–3.5 (4) mm. long; *bracteoles* 0–2, commonly present; *calyx* (4.6) 5.5–10.5 (11) mm. long, strigulose or pilosulous with white, fuscous, or black hairs, sometimes subglabrous medially, the strongly oblique disc (0.7) 1–2 mm. deep, the campanulate or rarely cylindro-campanulate tube (3.4) 4.1–8.5 (9) mm. long, the subulate, linear-subulate, or triangular teeth (1) 1.2–4.4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* greenish-white, cream-color, dull straw-yellow, or greenish tinged with dull or lurid purple; *banner* broadly oblanceolate or spatulate, shallowly notched, (11.3) 13.2–17 (17.5) mm. long, (4.3) 4.7–8.2 mm. wide; *wings* (10.1) 11.3–15.3 mm. long, the blades narrowly oblong or lance-oblong, obtuse, obliquely truncate, or rarely bidentate, straight or distally a trifle incurved, the inner margin crispate-undulate toward the middle, the auricle large, mostly 1.2–2.4 mm. long; *keel* (9.5) 10.2–13.6 mm. long, the blades obliquely oval, half-oval, or -obovate, gently or quite abruptly incurved through 90–95° to the blunt deltoid apex; *anthers* 0.5–0.75 (0.8) mm. long; *pod* erect, sessile on the slightly elevated receptacle, oblong-

cylindroid or -ellipsoid, (9) 10–20 mm. long, 2.9–5.2 mm. in diameter, rounded or truncate at base, abruptly contracted distally into a rigid, erect or quite strongly porrect, cusplike beak 1.5–5 mm. long, either terete or grooved dorsally, obtusely carinate ventrally by the prominent, thick suture, the green, somewhat fleshy, glabrous, strigulose, or exceptionally villosulous valves becoming stiffly papery or leathery, brown and ultimately blackish, transversely rugulose-reticulate and sometimes also tuberculate and wrinkled lengthwise, filamentous within, inflexed as a complete or subcomplete septum 1.5–4.5 mm. wide; *dehiscence* tardy, through the beak and part way downward through the ventral suture; *ovules* (16) 18–26 (28); *seeds* greenish, ochraceous, grayish-brown, or castaneous, smooth but dull, (1.4) 1.7–2.4 mm. long.

The Canada milk-vetch is easily recognized in our flora by its combination of rhizomatous root-system (unfortunately shown by only a small proportion of the herbariums specimens), dolabriform vesture, at least some connate stipules, nodding flowers of dingy greenish- or yellowish-white sometimes tinged with lurid purple, and by the rather small, erect, fully bilocular pods of oblong-ellipsoid outline. It is the New World's most widely dispersed astragalus, ranging from the Gulf Coast in eastern Texas to the Appalachians and lower St. Lawrence River, west to the southern Rocky Mountains and the Great and Columbia Basins, where it is found in a variety of habitats, its one consistent requirement being plentiful moisture at least during the period of active growth. The adaptation of *A. canadensis* to diverse climates, soils, and environments has gone hand in hand with racial differentiation, although this is not of a marked character. The species is readily divisible into two main branches, one widespread east of the Rocky Mountains and the other primarily intermontane, although each intrudes here and there across the Continental Divide, as noted below in greater detail. The eastern branch is characterized by a terete pod, the western one by a pod more or less deeply grooved dorsally. It has often been claimed that the eastern plants, including with the Linnean *A. canadensis* the var. *longilobus*, *A. carolinianus*, and *A. Halei*, are distinguished from their western counterparts by a glabrous pod but this is not always so. In the upper Mississippi Valley, especially in Minnesota, the ovary of typical *A. canadensis* is often puberulent, and the ripe pod is occasionally quite densely strigulose; occasionally in the Northwest a very thinly puberulent ovary ripening into an almost or truly glabrous, dorsally sulcate fruit is encountered. This character of pubescence, which would be so useful in the case of flowering material, cannot unfortunately be relied on, although it may be of limited use at the points where the two principal branches of the species coincide in range.

Both east and west of the Rocky Mountains racial differentiation is evidently in progress; the modifications, however, are very slight and the emergent races for the most part impossible to define in mutually exclusive terms. In the East, there are faint and indecisive signs of a northward and southward dichotomy, mentioned further under var. *canadensis*. The western material falls into two fairly well-marked categories in which small morphological differences are correlated with habitat and distribution. The species is understood here to be composed of three varieties.

For over two centuries it has been recognized that *A. canadensis* is related to the Siberian *A. uliginosus* L., which seems to be separable from some of the western forms of Canada milk-vetch with sulcate pods chiefly by its ordinarily glabrous (but perhaps sometimes puberulent—cf. Komarov, *Pl. Manshur.* 951, NY) ovary and broadly lance- or ovate-acuminate bracts. In the context of the section and genus these differential characters are trifling enough, and I have no doubt that despite the great discontinuity in range the eastern Asiatic and North American plants should be considered as forming parts of a bicentrically dispersed species. Lack of material of the related *A. Schelichovii* Turcz. and *A. kamtschaticus* (Kom.) Gontsch. has prevented a thorough study of the problem without which changes in nomenclatural status would be improper. Granted that *A. canadensis* is derived from Asia, as I have speculated elsewhere, it would most nearly reflect the biological realities if the New World forms were reduced to varietal status under *A. uliginosus* L.

Key to the Varieties of *A. canadensis*

1. Pod grooved dorsally; ovary and pod almost consistently pubescent, even though very thinly so, but the pod sometimes glabrate; intermontane, from s. British Columbia to Nevada, e.-centr. California, extending e. to the upper North Platte in s. Wyoming and adjoining Colorado, to the Black Hills, South Dakota, and to the upper Yellowstone and Missouri Rivers in Montana (2)
2. Usually tall and slender plants of the mesic forest belt of the n. Rocky Mountains

(s. Canada to n.-e. Oregon and centr. Idaho), the stems mostly 3–7 (9) dm. long; *calyx-teeth* (1.5) 2–4.4 mm. long, the ventral pair ordinarily not much broader though sometimes shorter than the rest; *beak* of the thinly strigulose or glabrate pod (excluding the deciduous style-base) 3–5 mm. long

188a. var. *Mortoni*

2. Usually lower and more robust plants of sagebrush valleys and xeric pine forest in the transition zone of the Great and Columbia Basins, extending e. to s. Wyoming, adjoining Colorado, the Black Hills, and s. British Columbia, the stems mostly 1.5–5 dm. long; *calyx-teeth* 1–2.5 (3) mm. long, the ventral pair nearly always broadly triangular or deltoid and mostly shorter than the rest; *beak* of the more densely strigulose pod 1.5–3 mm. long

188b. var. *brevidens*

1. Pod terete, not sulcate dorsally; *ovary* and pod glabrous over the great part of the range, always so in the Rocky Mountains, often pubescent in the upper Mississippi Valley; mostly eastern, extending w. to the upper Yellowstone River in Montana, to the e. slope of the Colorado Rocky Mountains, n. New Mexico, and across the divide to the head of the San Juan River in s.-w. Colorado; apparently an occasional introduction in Idaho and perhaps elsewhere in the intermountain states

188c. var. *canadensis*

188a. *ASTRAGALUS CANADENSIS* var. *MORTONI*

Stems relatively slender, erect, simple, (2.5) 3–7 (9) dm. long; *herbage* dark green, thinly strigulose, the hairs up to 0.3–0.65 (0.7) mm. long, the inflorescence usually fuscous-pilosulous; *stipules* 3.5–11 (14) mm. long, the sheathing lower ones not ruptured, persistent; *leaves* (3) 6–19 (22.5) cm. long, with (9) 13–19 (21) ample, thin-textured leaflets 1–4.5 (5) cm. long; *peduncles* rather slender, 6–22 cm. long; *racemes* at full anthesis 2.5–12 cm. long, 2.7–3.5 cm. in diameter, sometimes interrupted toward the base; *pedicels* in fruit 1.4–2 mm. long; *calyx* (6.5) 7.4–10.5 (11) mm. long, the tube (5) 5.5–6.7 mm. long, strongly oblique or gibbous at base, (3) 3.4–4.9 mm. in diameter, the teeth (1.5) 2–4.4 mm. long; *petals* greenish-white or ochroleucous, the banner often margined with lurid purple; *banner* (12.6) 13.2–16.5 mm. long (4.3) 6–8.2 mm. wide; *wings* (11.3) 11.7–15.3 mm., the claws (5.2) 5.7–7 mm., the blades (7.3) 7.6–10.5 mm. long, 1.7–2.8 mm. wide; *keel* (10.4) 10.6–13.1 mm. long, the claws (5) 5.4–6.7 mm., the blades (5.5) 5.7–7.3 mm. long, (2.5) 2.7–3.6 mm. wide; *body* of the *pod* (9) 11–20 mm. long, 3–5 mm. in diameter, the *beak* (3) 3.5–5 mm. long, the *septum* (2) 2.5–3.4 mm. wide; *ovules* (16) 18–26.—Collections: 99 (iv); representative: *Cronquist & Jones* 5901, 5967 (CAS, ID, NY, SMU, RSA, WS); *Hitchcock & Muhlick* 13,676 (NY, RSA), 13,698, 13,859 (NY, RSA, WS); *C. L. Hitchcock* 17,572 (ID, RSA, WS), 17,892, 18,177 (ID, NY, RSA, WS); *MacDougal & Leiberg* 475 (CAS, NY, WS); *Ripley & Barneby* 10,696 (CAS, RSA).

Open coniferous forest, thickets in the forest zone, sometimes in deep shade but commonly in glades or openings, in moist or cool acid soils rich in humus, widespread and locally abundant about the north and west affluents of the Columbia River between 3000 and 6800 feet but descending along streams to moist depressions and lake shores in the yellow pine belt as low as 1600 feet, southern British Columbia south through eastern Washington to the Blue and Wallowa Mountains in northeastern Oregon, east through central Idaho and northwestern Montana to Glacier Park and Deer Lodge Valley, extending just over the Divide into the upper Missouri drainage.—Map. No. 75.—June to September, the fruit persisting until snow.

ASTRAGALUS CANADENSIS var. *MORTONI* (Nutt.) Wats., Bot. King 68. 1871, quoad nom., based on *A. Mortoni* (Samuel George Morton, 1799–1851, physician and paleontologist, early member and officer of the Philadelphia Academy) Nutt. in Jour. Philad. Acad. 7: 19. 1834.—“About the sources and upper branches of the Missouri . . . [Nathaniel B. Wyeth].”—Holotypus, labeled in Nuttall's hand “*Astragalus *Wyethii*. Sources of the Missouri,” with Gray's annota-

tion "published as *A. Mortonii*," PH! isotypi, BM! and labeled "*A. Mortonii* Nutt. Herb. Wyeth.," NY (herb. Torr.)!—*Tragacantha Mortonii* (Nutt.) O. Kze., Rev. Gen. 946. 1891. *Phaca Mortonii* (Nutt.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 372. 1906.

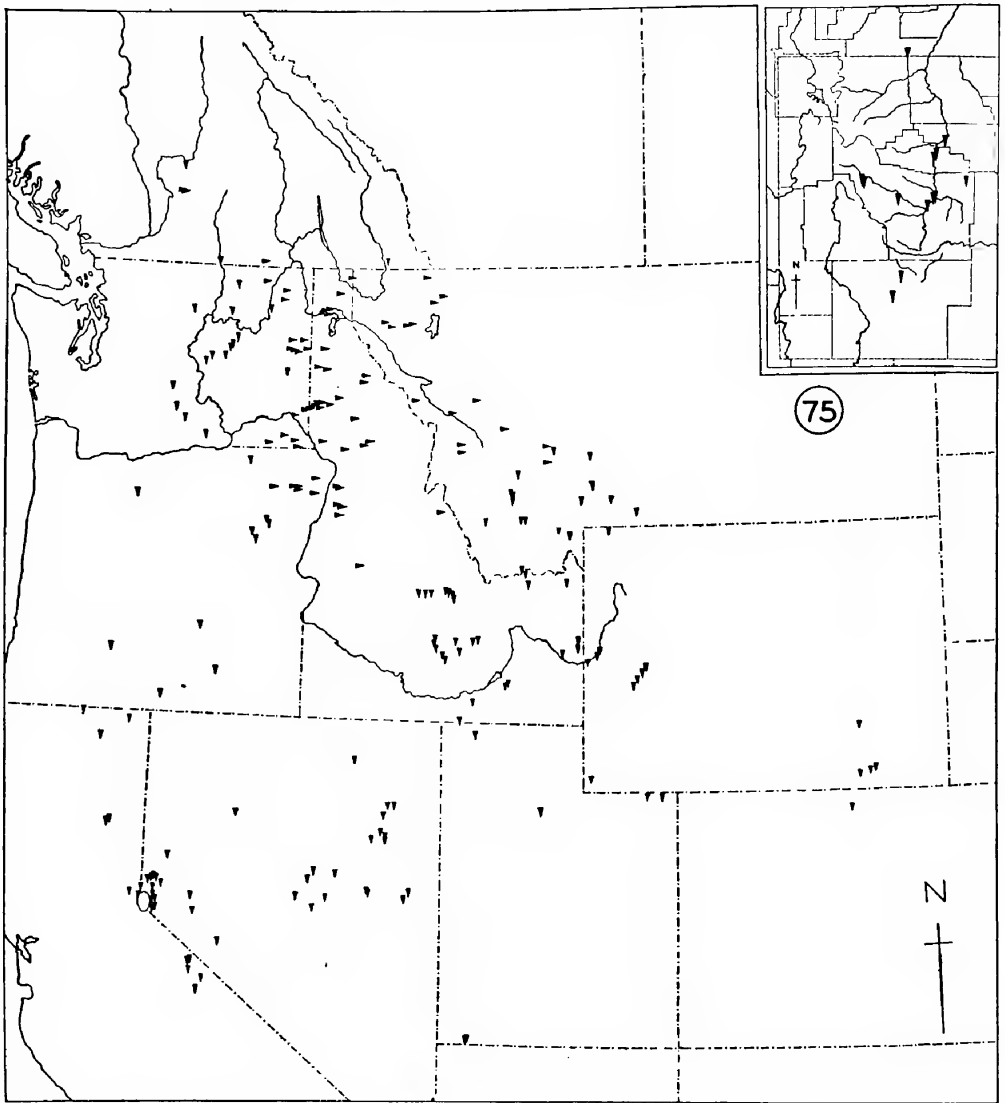
The var. *Mortonii* is the commonest milk-vetch encountered in the forest belt in the north half of Idaho, northwestern Montana and eastern Washington, and is sometimes abundant over large areas. It is ordinarily a tall, comparatively slender plant, with thin-textured foliage of a dark green color, a more or less fuscous- or black-hairy inflorescence, and flowers varying from greenish-white to cream-color, often suffused with lurid purple. In the past the name has been applied partly or wholly to the next variety in the majority of texts.

188b. *ASTRAGALUS CANADENSIS* var. *BREVIDENS*

Usually of lower, comparatively more robust growth than var. *Mortonii*, the erect or sometimes decumbent and ascending stems (1) 1.5–5.5 dm. long; *herbage* usually paler green, the leaflets commonly glabrous but sometimes (especially in western and central Nevada) thinly or even cinereously strigulose above, the hairs up to 0.5–0.9 (1) mm. long, the inflorescence either white- or fuscous-pilosulous; *stipules* (3) 4–14 mm. long, all connate, but the upper ones often shortly so, the sheath ruptured only in some very robust specimens; *leaves* 5–15 (23) cm. long, with (7) 15–23 (25) nearly always mucronulate leaflets (0.5) 0.7–3 (4) cm. long; *peduncles* stout, (4) 5–15 (20) cm. long, either longer or shorter than the leaf; *racemes* (2.5) 4–9.5 (15) cm. long, 2.5–3.5 cm. in diameter at full anthesis; *pedicels* in fruit 1.2–3.5 (4) mm. long; *calyx* (6.8) 7.1–10.5 (11) mm. long, the tube (4.6) 5.1–8.5 (9) mm. long, 3.2–5 mm. in diameter, the broadly subulate or deltoid teeth (1) 1.3–2.5 (3) mm. long, the ventral pair nearly always much broader and commonly shorter than the rest; *petals* ochroleucous, stramineous, or greenish-white, rarely tinged with dull purple; *banner* (11.7) 12.5–17 (17.5) mm. long, (4.6) 5–8 (8.8) mm. wide; *wings* (10.4) 11–15 mm., the claws (5) 5.4–7.4 (7.7) mm., the blades (6.3) 6.7–10 mm. long, (1.6) 1.8–3 mm. wide; *keel* (8.9) 10–13.6 mm., the claws (4.7) 5.1–7 (7.5) mm., the blades (4.4) 5–7.1 mm. long, (2.2) 2.6–3.5 (3.7) mm. wide; *body of the pod* (9) 10–15 mm. long, 2.9–4 (4.5) mm. in diameter, the beak 1.5–3 mm. long, the septum 1.5–3 mm. wide; *ovules* (17) 18–25 (28).—Collections: 171 (vii); representative: *Sandberg & Leiberg* 341 (CAS, NY, WS); *C. L. Hitchcock* 16,811 (NY, RSA, SMU, WS), 17,513 (ID, NY, RSA, WS); *Cusick* 341 (CAS, NY, WS); *Hitchcock & Muhlick* 9595, 10,759 (CAS, NY, WS, WTU), 12,570 (CAS, NY, RSA, WS); *Christ* 15,509 (ID, NY, RSA); *C. L. Porter* 2795 (NY, SMU, TEX, WS); *L. S. Rose* 50,158 (CAS, NY, RSA); *A. Heller* 12,904 (CAS, NY, WS); *Maguire & Holmgren* 22,234 (NY, WS, WT), 26,018 (NY, RSA, WS); *Ripley & Barneby* 4046 (CAS, NY, RSA, WS).

Moist but often summer-dry bottomlands, ditches, creek banks, lake shores, hillsides about springs and seeps, alkaline meadows, and depressions on rolling plains, rarely in dry (or apparently dry) sandy or gravelly soils of brushy hills or lava flows, (750 northward) 1500–8100 feet, mostly in stiff, often alkaline, alluvial soils of diverse origin, commonly with sagebrush but ascending along water courses into xeric pine forest, widespread, common, and locally abundant, often forming extensive clumps or colonies, nearly throughout the western and northern Great and Columbia Basins, from eastcentral and northeastern California to interior Washington and southern British Columbia, east to the upper Missouri in southwestern Montana, the upper North Platte River in southern Wyoming and northwestern Colorado, northern Utah, and central Nevada; southwestern Utah (Washington County).—Map No. 75.—June to September.

ASTRAGALUS CANADENSIS var. *BREVIDENS* (Gand.) Barneby in Leaflet. West. Bot. 4: 238. 1946, based on *A. Mortonii* fma. *brevidens* (short-toothed, of the calyx) Gand. in Bull. Soc.



Map No. 75. Left, parts of western United States and adjoining Canada. Range (in part) of *A. canadensis*: ♦ var. *Mortoni* and ◀ var. *brevidens*. Top right, western Wyoming and adjoining Montana. Range of *A. oregonus*.

Bot. Fr. 48: xvi. 1902.—“Nelson exs. no. 3842 . . . Wyoming ad Evanston.”—Holotypus, not found and not catalogued (1962) at LY; isotypi, *A. Nelson 3842*, collected July 27, 1897, NY, RM!

Astragalus spicatus (spicate, of the raceme) Nutt. ex T. & G., Fl. N. Amer. 1: 336. 1838.—“Plains, near streams, in the Rocky Mountains Range.”—Holotypus, labeled by Nuttall “*Astragalus *spicatus*. R. Mts. Columb.,” BM! isotypus, NY!—*A. pachystachys* (with thick spikes) Rydb. in N. Amer. Fl. 24: 448. 1929, a legitimate substitute (non *A. spicatus* Pall., 1777) but later homonym (non *A. pachystachys* Bge., 1869).

Astragalus tristis (sad, from the black-hairy calyx) Nutt. ex T. & G., Fl. N. Amer. 1: 336. 1838.—“Rocky Mountains, towards the sources of the Platte . . . Nuttall.”—Holotypus, labeled by Nuttall “*Astragalus *tristis*. R. Mts.,” BM!

Astragalus Mortoni fma. *Rydbergii* (Per Axel Rydberg, 1860–1931) Gand. in Bull. Soc. Bot. Fr. 48: xvi. 1902.—“Rydberg, Expl. of Mont. exs. no. 4475 . . . in Montana, ad Jack Creek Canon, alt. 7000 ped.”—Holotypus, not found and not catalogued (1962) at LY; isotypus, *Rydberg & Bessey 4475*, collected July 19, 1897, NY!

Astragalus Torreyi (John Torrey, 1796–1873) Rydb. in N. Amer. Fl. 24: 448. 1929.—“Type collected near Empire City, Nevada, in 1865, *Torrey*.”—Holotypus, NY!

Astragalus brevidens (short-toothed, of the calyx) Rydb. in N. Amer. Fl. 24: 450. 1929.—“Type collected 3 miles north of Whitney, Baker County, Oregon, Febr. [actually July] 22, 1921, *M. Peck 10360* . . .” —Holotypus, NY!

The var. *brevidens* is closely related to var. *Mortoni*, with which it has often been inadvertently confused or deliberately united as an inconsequential form. No one familiar with the slender woodland var. *Mortoni*, as it abounds in the forests of the Northwest, will be content to identify it with the typical and extreme phases of var. *brevidens*, as this occurs in the deserts of the Great Basin; but at the same time it is difficult to express the perceived reality in exact diagnostic terms. The form of the calyx-teeth, emphasized in the varietal key as a differential character, is somewhat variable. Some individual plants cannot be assigned to either variety on this basis alone unless the growth-habit and pod, unfortunately not often available in a late-flowering species, are taken into account. Practical difficulty occurs, however, only where the ranges of the two varieties meet in eastern Washington and adjacent British Columbia. The forms of var. *brevidens* found on the upper Columbia River and its affluents sometimes approach var. *Mortoni* in calycine characters, but the short-beaked pod is densely, often canescently villosulous with short, crisped hairs and thus easily distinguished from the glabrescent, long-beaked pod of var. *Mortoni*. In the same area var. *brevidens* is found around potholes on the basalt plains, about seeps and springs in the coulees, and on the shores of alkaline lakes and ponds; whereas var. *Mortoni*, although it does come out and down to the edge of the sagebrush around Spokane and elsewhere, is almost always associated with timber. Near their common frontier in southern Idaho and southwestern Montana, the varieties are more abruptly separated morphologically.

The var. *brevidens* is less variable than might be expected from its wide horizontal and vertical range, or from the weight of synonymy it has acquired through the years. Nuttall early distinguished two species, *A. tristis*, based on a single, small, flowering specimen, and *A. spicatus*, described from a larger, more mature plant. Both fall easily within the range of variation known in var. *brevidens*, the fuscous calyx of *A. tristis* being a not uncommon feature of the present variety and by no means diagnostic of var. *Mortoni*, as Rydberg (1929, p. 441, in clave) assumed. The leaflets of var. *brevidens* are glabrous above in all parts of its range except central and western Nevada, where they vary from very sparsely to quite densely, at times even canescently strigulose on both faces. This trivial modification seems to be consistent in each colony, but the colonies themselves are probably often clones propagating largely through the sucker-like stolons, and colonies so modified do not occupy any considerable area to the exclusion of the more ordinary glabrescent form. The more pubescent *A. Torreyi* is therefore to be classed as a minor variant. The plant described by Rydberg as *A. brevidens* was referred to sect. *Hypoglottides*, but is a typical example of the present variety and not related to *A. adsurgens*. The stipules of the holotypus, described as free, are clearly connate. The use of the epithet *brevidens* in independent descriptions of the same entity was a curious coincidence.

The short-toothed Canada milk-vetch was first collected on September 15, 1804, by Lewis and Clark on their outward journey (*No.* 46, PH, labeled “the growth of the open praries”).

188c. *ASTRAGALUS CANADENSIS* var. *CANADENSIS*

Variable in stature, but usually tall and robust, the stems either slender and almost solid or stout and hollow, (3.5) 4–12 (16) dm. long, usually branched or spurred at 1–several nodes preceding the first peduncle, sometimes simple, the herbage green or subcinereous, the leaflets commonly glabrous or glabrescent above, the longest hairs of the herbage up to (0.25) 0.3–0.7 mm., and of the inflorescence up to (0.4) 0.5–1.1 mm. long; *stipules* 3–18 mm. long, the lowest ones usually ruptured and irregularly circumsessile in age; *leaves* (3.5) 5–25 (35) cm. long, with (9) 15–35 broadly lanceolate, oblong, ovate, or elliptic, obtuse or mucronulate, or truncate-emarginate leaflets 0.6–4.5 cm. long, all paler beneath and carinate by the prominent suture; *peduncles* (2.5) 4–11 (13) cm. long, commonly $\pm$ half as long as the leaf; *racemes* usually dense, rarely looser and racemose, mostly 4–16 cm. long and (2) 2.5–3 cm. in diameter at anthesis; *pedicels* in fruit 1.2–2.5 mm. long; *calyx* (4.6) 5.5–9.6 (10.3) mm. long, mostly white-, rarely in part fuscous- or black-pilous, the tube sometimes glabrate, the tube (3.4) 4.1–6.7 mm. long, (2.5) 2.7–4.1 mm. in diameter, the teeth subulate or

linear-subulate, 1.2–4 (5.1) mm. long; *petals* greenish-white or dull straw-colored; *banner* 11.3–16.3 mm. long, 5–8 mm. wide; *wings* 10.1–14.5 mm. long, the claws (4.2) 5–7.1 mm., the blades 7–9.6 mm. long, 1.2–2.2 (2.5) mm. wide; *keel* 9.3–13 mm. long, the claws (4.6) 5–6.8 mm., the blades 4.9–7 mm. long, (2.2) 2.5–3.4 mm. wide; *body* of the *pod* (9) 10–15 mm. long, 4–5.2 mm. in diameter, terete or nearly so but carinate ventrally by the suture, the nearly always porrect cusp mostly 2–4 mm. long, the valves glabrous or more rarely puberulent, exceptionally strigulose; *ovules* (18) 20–26 (27).—Collections: 337 (iii); significant specimens cited in the discussion.

Low moist prairies, creek banks, roadside ditches, commonly in rich soils moist in spring, but also in dry rocky woodlands, on sandstone bluffs or cliffs, and on stony or sandy beaches and shores of lakes and rivers, westward on short-grass prairies, in mountain woodlands, and on stream banks, to the south sometimes in low sandy pine woods, mostly 10–3000 feet but ascending to 3500 feet in the Appalachians and to 7000 feet in Colorado, widely dispersed from southwestern Mackenzie and northern British Columbia to James Bay, Ontario, the St. Lawrence River, Quebec, and Lake Champlain, Vermont, south over the plains, through the Mississippi Valley (where commonest), and the Midwest to southwestern Texas, central Louisiana, northeastern Alabama, and along the Appalachians from West Virginia to northern Georgia, rarely east to northern New Jersey and the Coastal Plain in southeastern Virginia and the Carolinas; also along the east slope of the Rocky Mountains from Montana to northern New Mexico, and sparingly east of the Continental Divide in northern Idaho (Pend Oreille River, possibly introduced), Utah (Sevier Valley; Provo Canyon; Cache County; apparently native), and about the headwaters of the San Juan River in southwestern Colorado.—Map. No. 76.—May to September.

ASTRAGALUS CANADENSIS (Canadian) L., Sp. Pl. 757. 1753.—“*Habitat* in Virginia, Canada.”—Holotypus, labeled “*Astragalus* 3, Hort. Cliffort.,” LINN!

Astragalus carolinianus (of Carolina) L., Sp. Pl. 757. 1753.—“*Habitat* in Carolina.”—No spm. exists in herb. Linn. or in herb. Dillen. (OXF); lectotypus, Tab. 39, Dill., Hort. Eltham. 1: 45. 1732!—*A. canadensis* var. *carolinianus* (L.) Jones in Proc. Calif. Acad. Sci. II, 5: 647. 1895.

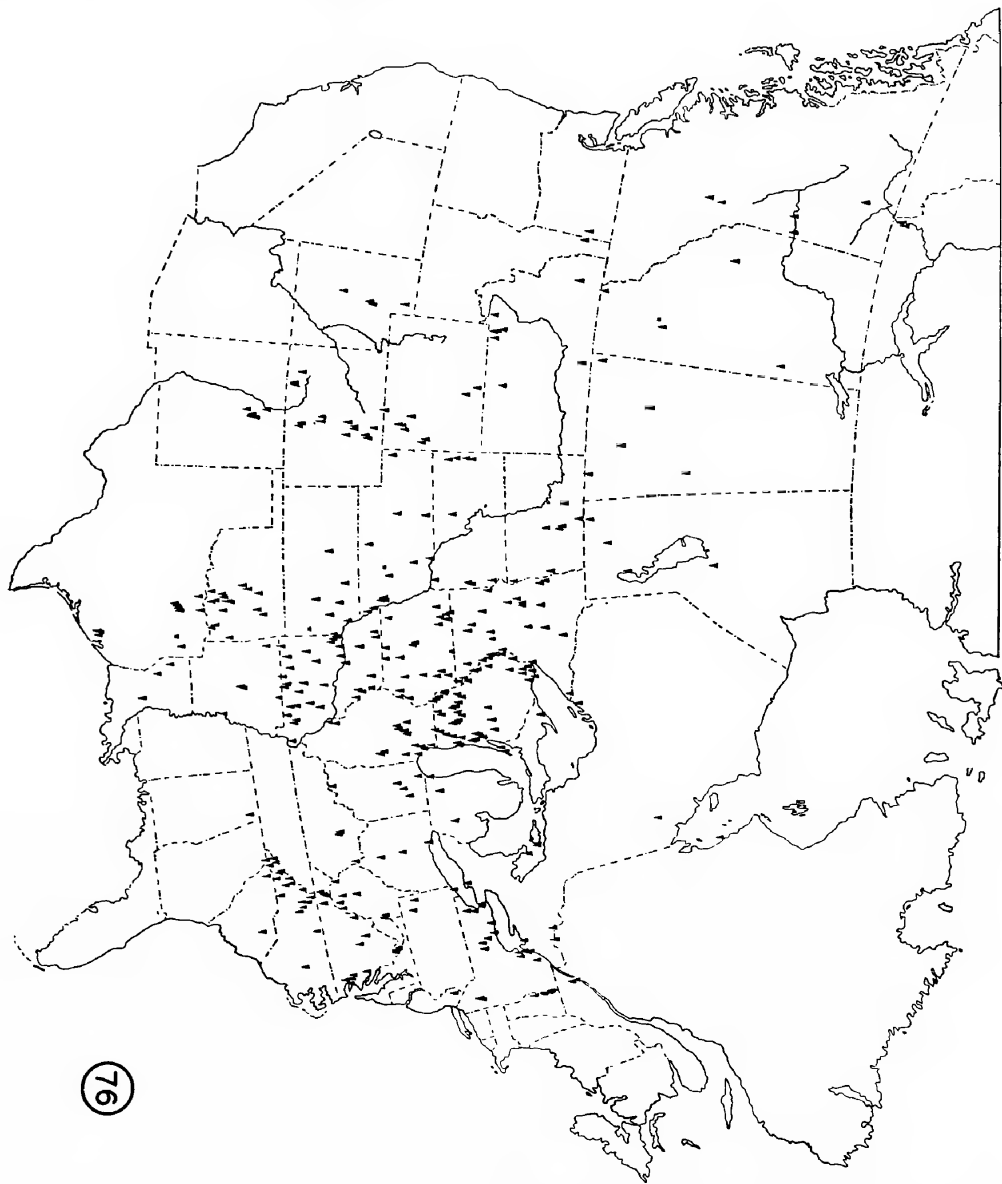
Astragalus canadensis fma. *monticola* (dwelling on mountains) Gand. in Bull. Soc. Bot. Fr. 48: xv. 1902.—“Colorado ad Fort Collins (Crandall). New Windsor (Osterhout), Wyoming (Nelson) et alibi in regione elata “Rocky Mountains” dicta.—Holotypus, collected “6–8 miles w. of Fort Collins, July 24–Aug. 8.,” LY!

Astragalus oreophilus (mountain-loving) Rydb. in Bull. Torr. Club 31: 561. 1904.—“COLORADO: Pagosa Springs, 1899, C. F. Baker 419 . . .”—Holotypus, collected in July, 1899, NY! isotypi, MO, ND, RM, US!

ASTRAGALUS HALEI (Josiah Hale) Rydb. in N. Amer. Fl. 24: 447. 1929.—“Type collected in Louisiana, Dr. Hale 313 (Torrey herbarium, flowers); also at Shreveport, Cocks 3624 (fruit).”—Cotypi, NY!

Astragalus canadensis var. *longilobus* (with long calyx-teeth) Fassett in Rhodora 38: 94. 1936.—“ . . . sandy roadsides, Binghampton, July 8, 1930, W. E. Rogers, No. 278 . . .”—Holotypus, WIS!—The type-locality is in Outagamie County, e.-centr. Wisconsin.

The circumscription of var. *canadensis* has been drawn rather broadly in order to include all forms of the species with pod rounded and not sulcate dorsally, whether glabrous or puberulent. The entity so defined is polymorphic, individual plants and populations showing considerable variation in stature, number of leaflets, length and density of the racemes, proportions of the calyx, and length of the banner. There is evidently some correlation between certain types of variation and dispersal patterns, but no reliable method of separating named geographic races has been found. The phase of the Canada milk-vetch that is presumed to have been cultivated in France in the XVII century is the comparatively slender one found along the lower St. Lawrence River in Quebec, where it occurs on river banks and on gravel bars of streams. Here the stems are ordinarily about 4–7 dm. long, the leaflets are 7–11 pairs, glabrescent, and relatively small, and the pod is consistently glabrous. The same phase, or one



Map No. 76. Parts of North America. Range of *A. canadensis* var. *canadensis* (some stations in the Carolinas after H. E. Ahles).

identical so far as can be determined from herbarium specimens, has been traced westward in scattered stations across southern Canada and adjoining United States, principally in shore habitats, and reappears in mountain woodlands and on shady stream banks in the Rocky Mountains of Alberta, Colorado, and northern New Mexico. The plant of the southern Cordillera has been segregated as *A. oreophilus*, but the supposedly broad and short bracts are not a reliable differential character. The commonest phase of the Canada milk-vetch extends over a wide area from upper New York to North Dakota and south through the Mississippi Valley to the Gulf Coastal Plain in eastern Texas. It differs from its northern-montane counterpart in its extremely robust habit of growth (the stems mostly 5–12 or even 16 dm. tall), in having mostly 11 to 17 pairs of ample leaflets on the average more densely pubescent, and in the pod which varies from glabrous to puberulent. However, numberless examples illustrate a passage between the ideally conceived variants, and even the extreme types are geographically scattered (e.g., *Marie-Victorin* 3210, NY, from Jacques-Cartier County, Quebec, with up to 31

ample leaflets, and many slender forms from as far south as Oklahoma). The specimens picked out by Rydberg as the basis of *A. Halei* are of the stouter type. But the spreading or reflexed pod, supposedly the special diagnostic feature of *A. Halei*, was described from a single specimen bearing fruits of the preceding season, battered by winter weather and empty of seeds; no form of *A. canadensis* with pods naturally reflexed is known to exist. Independently of variation in stature and amplitude of herbage, the calyx of var. *canadensis* varies a good deal in the proportion of teeth to tube. This is not simply a variation in length of the teeth alone; it is rather that the depth of the intervening sinuses determines the ratio of tube to tooth. A form with long teeth, especially frequent in the Great Lakes region, has been described as var. *longilobus*. In support of this proposal Fassett (Leg. Pl. Wis. 72. 1939) introduced a highly speculative history of the fortunes of *A. canadensis* in eastern North America during the close of the last Tertiary glaciation. According to Fassett's hypothesis, a primitive stock characterized by long calyx-teeth and sparse pubescence must have survived as relic populations in the Appalachians (Jones's var. *carolinianus*) and in Wisconsin's Driftless Area; whereas a contemporary stock distinguished by shorter calyx-teeth and more copious pubescence (corresponding with today's var. *canadensis* in a restricted sense) was obliged to retreat southward. As the ice sheets moved northward, the southern population followed and eventually meeting the Wisconsin relics merged with them to produce a distinct entity, var. *longilobus*, supposed to combine the pubescence of the immigrants with the long calyx-teeth of the old native stock.

Fassett based his hypothesis on assumptions which cannot be proved or are actually false. In the first place, the calyx-teeth of the so-called relic var. *carolinianus* are consistently long only in the literature, not in any natural range; I have recorded a variation of 1.9–3.8 mm. in plants of montane habitats ranging from West Virginia to Georgia. The teeth of var. *longilobus*, according to Fassett himself, vary from 2–3.7 (actually up to 5) mm.; but there are examples of teeth up to 3 mm. long from as far south as central Oklahoma, where the influence of the Wisconsin relics could hardly be expected to reach. Furthermore, if var. *longilobus* is the progeny of introgression between a *carolinianus*-like relic and a recent immigrant "var. *canadensis*," we must assume, in the absence of specimens from the Driftless Area and adjacent regions which combine the teeth of the latter variety with the pubescence of the former, that the tooth-character was consistently dominant and the pubescence-character consistently recessive. This point is no longer demonstrable now that the hypothetical Wisconsin relic has been replaced by hybrid offspring. It seems so much simpler (and as probably correct) to interpret the long calyx-teeth, which occur in scattered stations through a great part of the range of our inclusive var. *canadensis*, as no more than a simple variation coordinate with those found in many widely dispersed astragali in whose history glaciation can have played no part. Species of wide distribution generally exhibit statistically different modes and frequencies of variation in different parts of their ranges, and the fact that in *A. canadensis* relatively long calyx-teeth are prevalent in (although by no means confined to) the general region of the Great Lakes is neither especially surprising nor taxonomically significant.

Mention has already been made of a var. *carolinianus*, supposedly the *A. carolinianus* of Linnaeus (but see further, below), said to represent the Canada milk-vetch in the southern Appalachians. Like so-called *A. oreophilus* in the Rocky Mountains, the eastern mountain race is found along streams and in moist, deciduous woodland; it is commonly distinguished from var. *canadensis* of the Mississippi Valley and northward by a narrower and more open flowering and fruiting raceme, and the flowers at the same time are relatively small. There is something to be said in favor of recognizing an eastern montane variety, so long as we confine its distinguishing character to a loose raceme. It has been suggested (e.g., by Fernald, 1950, p. 911) that the calyx-teeth of var. *carolinianus* are longer than those of var. *canadensis*, but this is not the case; both calyx and flower can be matched, separately and together, in many individuals from lowland habitats in the middle Prairie States. It is worth recalling that Jones (1923, p. 168) originally defined var. *carolinianus* as ranging widely over the Southeastern States north at least to the Ohio River, and the concept of a montane Appalachian variety is comparatively modern.

The history of the Canada milk-vetch, the first astragalus described from North America, goes back to the latter half of the XVII century, when it was already under cultivation in Paris (Dodart, Mem. Acad. Roy. Sci. Paris 4: 257, cum tab. 1676). Old garden specimens are preserved in the Paris herbarium (P), but unfortunately none is dated. A form of *A. canadensis*, perhaps an independent introduction from the British colonies, was known to Dillenius in England about 1732; and Linnaeus saw it in Clifford's garden at Hartekamp shortly after. There are two specimens of *A. canadensis* in the Linnaean herbarium. Gray (in T. & G., Fl. N. Amer. 1 (Suppl.): 649. 1840) recognized the sheet labeled "Astragalus 3, Hort. Clifford." as genuine *A. canadensis*, but misidentified (and annotated) the second as *Phaca neglecta* (= *A. neglectus*). The first, properly considered the holotypus, was apparently collected by Kalm in

Canada. The second is a cultivated plant from the Upsala garden and much resembles the diffuse type of *A. canadensis*, mentioned further below, which is preserved as *A. canadensis flore viridi flavescente* in the herbarium of Dillenius.

The identity of *A. carolinianus* is somewhat controversial, for no type-specimen appears to exist. The account of the species in *Species Plantarum* is based entirely on Dillenius (Hort. Eltham. 1: 45, Tab. XXXIX. 1732), for the synonym of Royen (Fl. Leidensis 391. 1740) is merely a quotation from the same source. Even the key character differentiating between *A. carolinianus* and *A. canadensis* (stems respectively erect and diffuse) was borrowed by Linnaeus from Dillenius, and we must turn to *Hortus Elthamensis* and the Dillenian herbaria for first-hand information. Dillenius described two American *Astragali* which he recognized as related: an *A. Canadensis flore e viridi flavescenti* identified, probably correctly, with the plant published earlier by Dodart under the same phrase-name; and a new *A. procerior non repens flore e viridi flavescenti*, grown from seed collected in Carolina, the basis of the Linnaean *A. carolinianus*. Dillenius brought out several seemingly important differences between his two species. His *A. Canadensis* etc. was a comparatively low and diffuse plant from a creeping root, seldom over two foot (6 dm.) tall, with weak branching stems, 7–10 pairs of subglabrous leaflets pallid-glaucous but not pubescent beneath, and flowers yellowish-green on opening but turning a dull sooty color. By contrast *A. procerior* etc. had several stout stems up to 2–3 cubits ($\pm$ 9–13.5 dm.) tall arising together from the same root-crown, and leaflets in 7 or 8 up to 20 pairs, green and glabrous on the upper side and paler but also pubescent beneath. Dillenius insisted, however, that the chief differential character was found in the root, saying that *A. procerior* etc. "radicibus non repit," whereas "ille [*A. Canadensis* etc.] vero insigniter." A creeping subterranean caudex is an important feature of sect. *Uliginosi*.

The Sherard herbarium (OXF) possesses two specimens ostensibly from the Dillenian collections, which have a bearing on the identity of these two astragali, but they are far from conclusive and raise even more problems than they resolve. The first is labeled "*A. Canadensis flore viridi flavescenti* Dodart" and agrees pretty well with the description in *Hortus Elthamensis*. It represents an unusually slender, apparently sprawling form of var. *canadensis*; but as it consists of only part of the stem, the full stature cannot be determined and the nature of the root is, of course, unknown. The leaflets number 11–19, agreeing with the Dillenian diagnosis, but the pubescence is not really in accord. The specimen is annotated in an old (unfortunately unidentified) hand with the remark: "videtur potius *procerior*, non *repens*," but it conforms poorly with the original description of *A. procerior* etc. The second Dillenian specimen is a Catesby collection from Carolina, dated 1724. According to Vines & Druce (*The Dillenian Herbaria* 160. 1907) this ought to represent *A. procerior non repens* of *Hortus Elthamensis*, i.e., *A. carolinianus* L. Actually it is labeled "*A. Carolinianus foliis angustioribus glabris, floribus pallide luteis in spicis longissimis laxius dispositis*," does not agree at all closely with the description of *A. procerior* etc., and represents a quite different species, the native Carolinian *A. Michauxii*. So far as I was able to determine in 1962, no specimen of the genuine *A. procerior* etc. has survived among the Dillenian collections; and since there is no material of *A. carolinianus* in the Linnean herbarium, it seems proper to select Plate 39 of *Hortus Elthamensis*, which Linnaeus cited, as *typus* of the latter.

Several questions about the source and identity of *A. procerior* etc., and hence of *A. carolinianus*, remain unanswered. The Dillenian plate illustrates very exactly a robust form of *A. canadensis*, which might have originated in the Mississippi Valley but is not known to exist either in North or South Carolina today. It is definitely not the Appalachian form of var. *canadensis* which occurs in the Carolinas and which has usurped the epithet *carolinianus*. A robust form of var. *canadensis* does occur along the James River near Williamsburg in south-eastern Virginia and might have been introduced from that region into English gardens. But if the *A. procerior* etc. described by Dillenius was really a form of *A. canadensis*, it is most difficult to explain the differential character of a non-creeping root on which so much emphasis was placed. Curiously enough, the feature of a determinate (non-creeping) root-stock, accompanied by tall, wandlike stems and many pairs of leaflets, is characteristic of *A. Michauxii* which had been collected in fruit (and with apparently ripe seed) in Carolina and communicated to Dillenius about 1724. But the leaves of *A. Michauxii* are not pubescent beneath, the flowers are purplish and not greenish-yellow, and the raceme is much looser than that of any form of *A. canadensis*. Moreover, the floral details, especially the long wing-auricles, shown in the plate of *A. procerior* etc., are definitely taken from *A. canadensis*, not *A. Michauxii*. We may conjecture that Dillenius did actually see *A. Michauxii* growing and derived the root character and geographic origin of his *A. procerior* etc. from that source; but later, through some unexplained confusion of materials, he associated these details with a description and illustration of an altogether different plant, a form of *A. canadensis* probably not native to Carolina, North or South. The assumption that *A. carolinianus* came from the mountains of interior Carolina dates from Michaux's *Flora Boreali-Americana* (1802).

189. *ASTRAGALUS OREGANUS*

Low, rather stout and leafy, with an initial taproot and creeping, cordlike rhizomes, densely strigulose, strigose, or subvillosulous with flattened, straight and appressed, or somewhat twisted and loosely ascending hairs up to 0.6–1.2 mm. long, the stems and herbage pallid green beneath the ashen vesture, the leaflets somewhat bicolored, yellowish-green and sometimes less densely pubescent above; *stems* arising singly or few together from buds on the horizontal or obliquely ascending rhizomes, 6–20 cm. long, naked, simple, slender and subterranean for a space of 3–10 (14) cm., upon emergence stouter, decumbent with ascending tips, branched or spurred at nearly all nodes below the first peduncle, the internodes all short, not over 3 cm. long and mostly shorter, becoming stiffly flexuous or abruptly zigzag distally; *stipules* papery, pallid or early becoming so, (2.5) 3.5–11 mm. long, amplexicaul and connate through at least half, the lowest through more than half their length into a loose, bidentate sheath; *leaves* divaricate or ascending, (2.5) 5–15 cm. long, shortly petioled, with (7) 9–15 (reportedly 21) broadly obovate or suborbicular-obcordate, obtuse or widely and shallowly notched, flat leaflets 4–20 mm. long, these usually diminishing upward along the rachis; *peduncles* erect or divaricate from the stem, vertical to the ground, 1.5–5.5 cm. long, much shorter than the leaf; *racemes* rather densely (15) 20–35-flowered, at full anthesis shortly oblong-cylindric, sometimes interrupted at base, the flowers nodding, the axis somewhat elongating, 3–7.5 cm. long in fruit; *bracts* scarious, ovate, lance-elliptic, or oblanceolate, 2–5.5 mm. long; *pedicels* ascending or a little arched outward, at anthesis 0.6–1.3 mm., in fruit thickened, 1.2–2.2 mm. long, persistent or sometimes very tardily disjoining under pressure; *bracteoles* linear-setaceous, up to 1.5 mm. long, attached at or below base of calyx; *calyx* 6.5–10 mm. long, thinly strigulose with white and often some fuscous hairs, the oblique disc 0.8–1.6 (2) mm. deep, the deeply campanulate or subcylindric tube obliquely truncate or dorsally subgibbous at base, 5.5–7.3 mm. long, 3.2–4.8 mm. in diameter, the subulate teeth 1–3 mm. long, the whole pallid, becoming papery, ruptured, marcescent; *petals* ochroleucous, concolorous, subpersistent; *banner* recurved through 50–90°, 15.5–19 mm. long, the cuneate claw expanded into an oblong or ovate-oblong, deeply notched blade 7.5–9 mm. wide; *wings* 13.2–17.6 mm. long, the claws 5.3–7.2 mm., the narrowly oblong or oblanceolate, truncate or retuse, nearly straight blades 8.4–12.4 mm. long, 2.7–3.1 mm. wide; *keel* 11.5–13.5 mm. long, the claws 5.4–6.7 mm., the lunate or lunately elliptic blades 6–7.2 mm. long, 2.9–3.2 mm. wide, incurved through 50–80 (90)° to the bluntly triangular apex; *anthers* 0.6–0.8 mm. long; *pod* erect or ascending at a narrow angle, sessile, persistent, oblong in profile, nearly straight or incurved through up to ¼-circle, 1–1.5 (1.8) cm. long, (3) 4–6 mm. in diameter, rounded or subtruncate at base, abruptly contracted at apex into a shortly triangular-acuminate, erect or slightly declined, rigidly cuspidate beak, a trifle obcompressed, bluntly keeled ventrally by the thick, prominent suture, openly and shallowly grooved dorsally, the fleshy, green, thinly strigulose valves becoming brown and leathery, almost smooth or transversely rugulose-reticulate, inflexed below the unilocular beak as a complete septum; *ovules* (17) 20–28; *seeds* not seen ripe.—Collections: 17 (v); representative: *A. Nelson* 7051 (GH, K, MO, NY, RM); *C. L. Porter* 4242 (NY, RM, SMU, TEX); *Ripley & Barneby* 7980 (CAS, NY, RSA, UTC), 7999 (CAS, RSA); *W. E. Booth* 54,560 (RSA).

Barren bluffs, gullied knolls, dunes, and detritus under cliffs or buttes, in sandy or sandy clay soils derived from weathered sandstone, sometimes on alkaline clay flats moist in spring, 3800–6800 feet, locally abundant along the upper Big Horn and Wind Rivers, from a point a few miles below Dubois, Fremont

County, Wyoming, downstream just into southern Carbon County, Montana, and south just across the Continental Divide to the edge of the Red Desert in Sweetwater County, Wyoming.—Map No. 75.—June to August.

ASTRAGALUS OREGANUS (of the Oregon or Snake River, a misnomer) Nutt. ex T. & G., Fl. N. Amer. 1: 335. 1838 ("*Oreganus*").—"Plains of the Rocky Mountain Range towards the sources of the Oregon . . . Nuttall."—Holotypus, BM! isotypus, NY!

Astragalus ventorum (of the winds, or Wind River) Gray ex Wats. ap. Parry in Amer. Midl. Nat. 8: 212. 1874.—"Collected on Wind River."—Holotypus, C. C. Parry 65, collected in 1873 on the Northwest Wyoming Expedition, GH! isotypus, K!—*Tragacantha ventorum* (Gray) O. Kze., Rev. Gen. 949. 1891.

The Wind River milk-vetch, *A. oreganus*, is presumably a recent derivative of *A. canadensis* var. *brevidens* with which it has in common almost all important technical characters. The flowers and pods are essentially identical in structure, but *A. oreganus* has acquired a certain individuality of aspect correlated with its adaptation to an arid environment. Wherever I have seen it, *A. oreganus* is a pronounced xerophyte, but the xerophytic specialization is not absolute, for the species has been found in Fremont County in "wet places on alkaline flats" (Beetle 4545, RM), a situation where one would expect to find var. *brevidens* at home. As compared with the average var. *brevidens*, the Wind River milk-vetch is a dwarfier plant, remarkable for the slenderness and length of the cordlike rhizomes, for the short stems commonly branching into fan-shaped sprays of foliage, and for the comparatively few pairs of broad, emarginate leaflets. As a rule, the peduncles are shorter and the pod proportionately or absolutely broader than in var. *brevidens*. Nevertheless it has become increasingly difficult, as material has accumulated, to distinguish *A. oreganus* by constant or substantial differential characters. Its range fits neatly into a gap in that of var. *brevidens*, fulfilling the conditions of a geographic subspecies. In habit of growth *A. oreganus* resembles *A. camptopus* of southwestern Idaho, a species also found on dunes and barren sandy bluffs or knolls. The affinities of the two species are exceedingly remote, but the similarity is worth noting as an example of parallel evolution shaped by circumstance.

Long known only from Nuttall's meagre type-collection, which has flowers only, *A. oreganus* was referred by Gray (1864, p. 202) to sect. *Ocreati* next to *A. flavus* and *A. humistratus*. This interpretation was natural enough in absence of the bilocular fruit, for *A. oreganus* has the connate stipules and dolabriform vesture of the *Ocreati* and *Humistrati*, even though its rhizomatous habit and nodding flowers are so very different. Because of Gray's misunderstanding of its true nature and affinity, *A. oreganus* was not recognized in Parry's rediscovery on the Wind River, and this accounts for the description of *A. ventorum*. A much later collection from the Red Desert near Superior, Wyoming (Steamboat Mountain, *A. Nelson* 7051, cited above) was distributed under a third name, *A. solitudinis*. This name appeared in print in a fragmentary discussion (probably intended to be withdrawn in press) in Nelson's "New Plants from Wyoming XIV" (in Bull. Torr. Club 29: 402. 1902, following a note on *Trifolium scariosum*). So far as I can learn, *A. solitudinis* was not associated with a published description and is a nomen nudum.

LIV. Sectio ONOBRYCHOIDEI

Caulescent perennials, with superficial or very shallowly buried, determinate root-crown or caudex; *vesture* dolabriform; *stipules* membranous becoming scarious, in ours connate; *leaves* imparipinnate, ours with $\pm 11-25$ leaflets; *flowers* densely racemose or subspicate, ascending, of moderate size, the banner in ours $\pm 13-19$ mm. long; *pedicels* short, sometimes subobsolete, disjointing in age; *calyx-tube* cylindric or deeply campanulate; *petals* whitish, ochroleucous, bluish, or magenta-purple (drying bluish), regularly graduated, the little recurved banner much longer than the obtuse keel; *pod* (in ours) erect or ascending at a narrow angle, sessile or shortly stipitate, often tardily deciduous by irregular fracture of the stipe (but not neatly disjointing), the body narrowly oblong or oblong-elliptic in profile, nearly straight, triquetrously compressed, fully bilocular, the valves papery; *dehiscence* apical and downward through both sutures, the pod ultimately separating into halves; *ovules* in ours 9-18.—Spp. 40 or more (in need of critical revision), all Eurasian, but 1 widely dispersed from eastern Asia through the

Yukon Valley and western Canada south to interior Washington, central Idaho, Wyoming (possibly central Utah), in the Rocky Mountains to Colorado, and over the Great Plains to northern Iowa, Nebraska, and northeastern New Mexico.

ASTRAGALUS sect. *ONOBRYCHOIDEI* DC., Prod. 2: 285. 1825, sens. restr.—Sp. lectotypica: *A. Onobrychis* L.

Glandula Medik, Vorles. Churpf. Phys. Ges. 2: 374. 1787.—Generitypus: *G. leontina* (Wulf.) Medik = *A. leontinus* Wulf.

Astragalus phalanx Onobrychoidei Pall., Astrag. vii. 1800.—Sp. lectotypica: *A. Onobrychis* L.—DC., Astrag. 10. 1802.

Macrosema Stev. in Bull. Soc. Nat. Mosc. 4: 266. 1832 (reprinted in Nouv. Mém. Soc. Nat. Mosc. 3: 105. 1834), sine descr.; Bull. Soc. Nat. Mosc. 29: 145. 1856.—Lectogeneritypus: *A. Onobrychis* L.

Astragalus sect. *Onobrychides* Gray in Proc. Amer. Acad. 6: 197. 1864, sens. restr.—Sp. lectotypica (by implication, although not actually mentioned): *A. Onobrychis* L.

Astragalus subgen. *Cercidothrix* sect. *Onobrychium* Bge., Gen. Astrag. Geront. 1: 100. 1868.—Sp. lectotypica: *A. Onobrychis* L.—*A.* sect. *Cercidothrix* subsect. *Onobrychium* (Bge.) Rouy, Fl. Fr. 4: 181. 1899.

Astragalus sect. *Onobrychium* ser. *Onobrychoidei* Boriss. in Fl. U. R. S. S. 12: 484. 1946, the typical series of the section.

Astragalus sect. *Onobrychium* sect. *Sibirici* Boriss. in op. cit. 12: 509. 1946.—Sp. lectotypica: *A. austrosibiricus* Schischk.

The sect. *Onobrychoidei* is a large and critical one, chiefly Asiatic in dispersal, and a discussion of its limits and affinities in the genus is outside the scope of this work. It must suffice to say that its relationships lie with more or less sympatric groups in the Old World, the one American species being clearly a comparatively recent immigrant in our flora, even though its arrival most probably antedates the last Tertiary glacial period. The foregoing description of the section is deliberately incomplete, since it applies in particular only to the sectional typus and to the species described below; it would require considerable revision and expansion before it could be applied usefully in an Asiatic context. A definition admittedly too narrow seems preferable, however, to one compiled from second-hand sources.

The nomenclature of the section goes back to the monographs of Pallas (1800) and DeCandolle (1802), both of whom established under the epithet *Onobrychoidei* a supposedly natural series or so-called phalanx, of which I have arbitrarily taken *A. Onobrychis* L. as the typical species. These phalanxes were only vaguely defined, however, and are heterogeneous in substance. The *Onobrychoidei* of DeCandolle's *Prodromus*, where the name was first published in the rank of sectio, was no more exactly or usefully delimited; but since it is the earliest name in its category which can be typified by *A. Onobrychis*, it must replace the better-known or at least recently more familiar *Onobrychium* Bge. Gray's sect. *Onobrychides* is evidently a technical synonym, but the group assembled under that name, which included *A. Hypoglottis* L. and its American ally *A. agrestis*, is natural only in a loose sense. The section emerged as a precise concept defined by substantial characters in Bunge's monograph. Although considerably enlarged by subsequent discoveries, sect. *Onobrychium* has withstood the test of time with only small modifications and is still in current use in Asiatic and European floras. The species found in Russia have been arranged by Borissova (1946, p. 479, sequ.) in nine series. Her *Sibirici*, among which *A. austrosibiricus* seems the reasonable choice of typus, are set off from the remainder by having the banner widest above the middle, thus spatulate or oblanceolate in outline, rather than tapering upward from below the middle as in the majority of central Asiatic *Onobrychoidei* and the original *A. Onobrychis*. The American species is a member of this series. The recent revision of sect. *Onobrychium* by Sirjaev (Rechinger & al., 1958) makes no allusion to the American representatives of the group.

190. *ASTRAGALUS ADSURGENS*

Commonly rather coarse but sometimes low, caulescent perennials, with a tough, woody taproot and knotty or shortly forking caudex, densely to quite thinly strigulose with fine, straight, appressed, dolabriform hairs up to (0.35) 0.55–1 mm. long, the herbage silvery-silky, greenish-cinereous, or green, the leaflets varying from densely pubescent to glabrous above; stems several or numerous, (0.2) 0.5–3 dm. long, ascending from the decumbent base or less often erect, commonly simple or simple except for 1–2 spurs arising from axils immediately preceding the first peduncle (the spurs rarely produced into floriferous branches),

angular-striate, often zigzag distally, together forming low tufts or clumps of rounded outline; *stipules* 4–13 (16) mm. long, papery-scarious and pallid or early becoming so, briefly adnate to and sometimes also behind the petiole-base, amplexicaul and connate through $\frac{1}{3}$ or more of their length into a loosely or tightly clasping sheath, this becoming fragile and sometimes ruptured in age, the upper ones with triangular, lanceolate, or lance-acuminate, mostly erect blades; *leaves* 4–17 cm. long, the lower petioled, the upper more shortly so or subsessile, with (7) 11–25 oblong, linear-oblong, narrowly to broadly elliptic, lanceolate, or oval, obtuse, subacute, or rarely subretuse, flat or marginally elevated, often dorsally carinate leaflets (4) 8–27 (33) mm. long, the upper surface either smooth or pinnately veined; *peduncles* mostly stout, erect or incurved-ascending, ribbed, (3) 4–14 (17) cm. long, about equaling or well surpassing the leaf; *racemes* densely (7) 10–50-flowered, the narrowly ascending flowers imbricated in obovoid, subcapitate heads or cylindro-oblong spikes, the axis little elongating after anthesis, (0.6) 1–9 (13) cm. long in fruit; *bracts* membranous or subherbaceous distally, lanceolate or lance-acuminate, 2–8 mm. long; *pedicels* erect, at anthesis subobsolete or up to 0.5 (0.8) mm. long, in fruit a trifle thickened or clavate, up to 0.4–1 mm. long; *bracteoles* 0; *calyx* 4.8–10.5 mm. long, densely strigulose with mixed black and white, more rarely all white or all black, straight or sometimes crisped hairs, the disc 0.5–1.4 mm. deep, the cylindric or campanulate tube 3–7 mm. long, 2–3.2 mm. in diameter, often a little distended dorsally above the obliquely obconic base, the linear, subulate, or subulate-setaceous, erect or arcuately spreading teeth 0.6–4.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* variable in color, magenta-purple, reddish-lilac, dull slate-blue, pale milky-white (the keel then often deeply maculate), or whitish drying cream-color, all withering-persistent; *banner* nearly erect or gently recurved through $\pm 25^\circ$, oblanceolate, rhombic-oblanceolate, or spatulate, notched or rarely subentire at apex, 11–19.5 mm. long, 4–7 (9) mm. wide; *wings* 9.7–17.5 mm. long, the claws 4.1–8.3 mm., the narrowly oblong, linear-oblong, or oblong-oblanceolate, obtuse, obliquely truncate, or obliquely notched, straight or nearly straight blades (5.2) 5.8–10 mm. long, 1.3–2.5 mm. wide; *keel* 8–15 mm. long, the claws 3.8–8.3 mm., the half-elliptic or obliquely elliptic blades 4.2–7 mm. long, 1.7–2.7 mm. wide, incurved through $50\text{--}90^\circ$ to the blunt or sometimes sharply deltoid apex; *anthers* 0.5–0.8 mm. long; *pod* erect, sessile or shortly stipitate, the stipe when present up to 1.8 mm. long but concealed by the calyx, the body narrowly ovoid-, oblong-, or lance-ellipsoid, 5.5–12 mm. long, 2.3–4 mm. in diameter, straight or a trifle incurved, rounded or cuneate-obconic at base, contracted at apex into an erect or somewhat declined, cusplike beak 0.7–2.5 mm. long, triquetrously compressed with acute ventral and narrow but obtuse lateral angles, the lateral faces flat or low-convex, the dorsal face narrower, openly but often deeply sulcate, the thin, green, at length smooth, papery, stramineous valves densely strigulose with short, sinuous, and often some longer, straighter, mixed black and white or all white hairs, inflexed as a complete or almost complete septum 0.7–1.5 mm. wide; *dehiscence* ultimately through both sutures and the septum, the valves tending to twist outward; *seeds* dusky-olivaceous, dark brown, or nearly black, smooth but dull, 1.5–2.6 mm. long.

The standing milk-vetch, *A. adsurgens*, is easily recognized in our flora by the combined features of a determinate root-crown at soil-level, dolabriform pubescence, connate stipules which early become pallid and scarious, and narrowly ascending flowers crowded into headlike or spikelike racemes and giving rise to small, erect, trigonous pods invested by the marcescent petals and calyx. In the fruiting stage it is sometimes confused with low forms of *A. canadensis*, similar in the type of vesture and connate stipules; but the flowers of the Canada milk-vetch are reflexed when fully open, the stems arise from slender subterranean surculi, and the pod is broader, terete or less sharply three-angled, and of much thicker texture. The standing milk-

vetch is sympatric over a great part of its American range with *A. agrestis*, a species similar in the connate stipules and crowded inflorescence of ascending flowers, but quickly distinguished by its basifixed hairs, subterranean points of renewal, and shorter, broader pod hirsute with long, white hairs.

As early as 1831 Hooker (Fl. Bor.-Amer. 1: 149) expressed the opinion that the American astragalus that has passed in the twentieth century under the names *A. nitidus* or *A. striatus* was conspecific with the Siberian *A. adsurgens* Pall., and Gray upheld Hooker's judgment in 1864. There can be no question of the close kinship between the species of Pallas and our *A. striatus*. The habit of growth, the leaves and stipules, the shape and color of the petals, the form of the pod, and even the ovule number are all essentially the same in both. The flowers of *A. adsurgens* in Asia vary considerably in size and coloring, in very much the way that those of *A. striatus* vary in America, and segregates based on these variations in combination with slight alterations in the calyx have been proposed on both sides of the Pacific. I have not seen enough material from the whole Asiatic range to evaluate a racial situation involving such local geographic variants as *A. marinus* Boriss.; but there is sufficient material from Russia in this country (NY, US) to show that *A. adsurgens* and *A. austrosibiricus* B. Schischk., as defined in Flora U. R. S. S., are morphologically confluent in the same way that our *A. striatus*, *A. Chandonetii*, and *A. sulphurescens* run together into an indivisible complex. Peter-Stibál (1937, p. 63), faced with the same problem, concluded that there was but one variable species in the Chinese flora. Considered collectively the Asiatic forms of *A. adsurgens* differ from ours in the relative proportions of the calyx and banner. In the Old World plant the tube of the calyx is comparatively short, so that the claws of the wings and keel are further exerted than in the New World plant, and the aspect of the flower as seen in profile is perceptibly different. No other consistent differential character seems to exist. In America the lateral and dorsal sinuses between the calyx-teeth tend to be narrow and subacute, whereas in Asia they are commonly all wide and obtuse, the teeth being less crowded together toward the calyx's abaxial side. These are hardly characters of specific value, and a return to Hooker's concept of an amphipacific *A. adsurgens* can no longer be avoided.

The following key is designed for use in America only; the var. *adsurgens* is extremely polymorphic and may well cover several geographic races deserving coordinate status.

Key to the Varieties of *A. adsurgens*

1. Calyx short in relation to the banner, the latter 3-4 times as long as the calyx-tube; widespread in e. Asia 190a. var. *adsurgens*
1. Calyx relatively longer, the banner less than 3 times as long as the tube; North America (2)
 2. Pod sessile or nearly so, the stipe commonly 0, if at all developed not over 0.5 mm. long, usually no longer than wide; calyx-teeth mostly 1.4-4.2 mm. long; widespread from n. British Columbia (Liard River) s.- and e.-ward; introduced in Yukon 190b. var. *robustior*
 2. Pod shortly stipitate, the stipe 0.7-1.8 mm. long; calyx-teeth mostly 0.4-1 mm., rarely up to 2.1 mm. long; Yukon and Alaska 190c. var. *tananaicus*

190a. ASTRAGALUS ADSURGENS var. ADSURGENS

Habit of the species; calyx 4.8-7.6 mm. long, the tube 3-4.4 mm. long, 2-2.9 mm. in diameter, the linear or linear-subulate teeth 1.4-3 mm. long, mostly separated by wide and obtuse sinuses; petals purple, slate-blue, milky-white, or white turning creamy; banner 11-17.2 mm. long, 4.5-7 mm. wide; wings 9.8-14 mm. long, the claws 4.1-6.7 mm., the blades 6-8.3 mm. long, 1.3-2.2 mm. wide; keel 8-11.3 mm. long, the claws 3.8-7 mm., the blades 4.5-5.5 mm. long, 2.2-2.7 mm. wide; pod sessile or very shortly stipitate, the stipe less than 1 mm. long, the body $\pm$ 6-9 mm. long; ovules 10-16.—Collections: 28 (o).

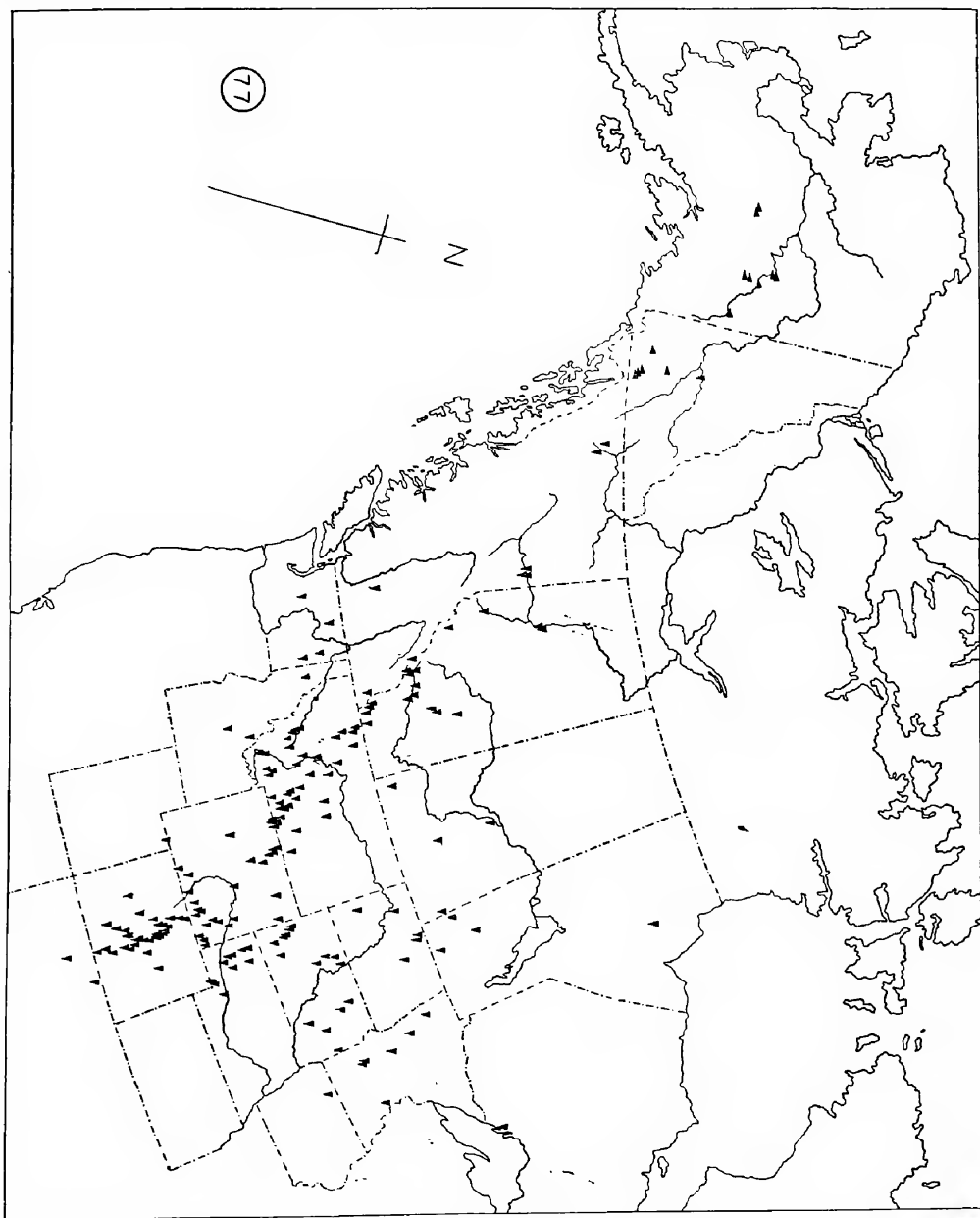
Widely dispersed over eastern Asia, from northeastern China through Mongolia to Altai, north in Siberia to the upper Irtysh and Lena Valleys; Japan.

ASTRAGALUS ADSURGENS (up-standing) Pall., Astrag. 40, Tab. 31. 1800.—"Crescit hic Astragalus tantum in regionibus Trans-Baicalensibus, cum *A. Laxmanni* promiscue, frequens ad Selengam, Ononem, circa Tarei-noor, et usque in Mongoliae desertum."—Holotypus, BM (herb. Pall.)!

Pallas described and figured *A. adsurgens* as having free stipules, and this character has been re-emphasized repeatedly, most recently by Borissova (1946, p. 508) and by Rechinger

& al. (1958, p. 336—"stipulae semiamplexicaules"). It often happens that the stipular sheath, although fully amplexicaul in veneration, becomes ruptured in age, especially if situated at a node on the main stem, which increases rapidly in girth during the period of spring growth. However it is nearly always possible to find on a plant of *A. adsurgens* some unruptured sheaths; this is true of the plant in the Pallas herbarium.

The name *A. adsurgens* has often in the past (initially by DeCandolle, 1802, p. 123) been considered a later synonym of *A. Laxmanni* Jacq. (Hort. Vindob. 3: 22, Tab. 37. 1776), a species based on plants grown in Vienna from seeds procured through Eric Laxmann. Pallas (1800, p. 36) claims to have sent the seeds to Laxmann, but the plant figured by Pallas (1800, Pl. 30) as *A. Laxmanni* is apparently not the genuine *A. Laxmanni* of Jacquin. According to Bunge (1869, p. 84) the true *A. Laxmanni* is a member of sect. *Hypoglottis*, a mesophytic species differing from all *Onobrychoidei* in its basifixed pubescence. In Flora U. R. S. S., *A.*



Map No. 77. Western Canada and United States. Range (in America) of *A. adsurgens*: ◆ var. *robustior*; and ▲ var. *tananaicus*.

Laxmanni is mentioned only as a sensu-name, in the synonymy of *A. austrosibiricus* Schischk. (a part of the *A. adsurgens* complex) and *A. tibetanus* Bth. ex Bge., despite its ostensibly Siberian origin. Probably *A. Laxmanni* is the earliest name for the widely dispersed and somewhat variable *A. tibetanus*, but its identity lies beyond the scope of this study. In early American literature the name *A. Laxmanni* refers to *A. adsurgens* var. *robustior*.

190b. ASTRAGALUS ADSURGENS var. ROBUSTIOR

Habit of the species; *leaves* 4–17 cm. long, with (9) 11–25 leaflets (4) 8–27 (33) mm. long; *peduncles* (3) 4–14 (16.5) cm. long; *racemes* (7) 16–50-flowered, the axis (0.6) 1.5–9 (13) cm. long in fruit; *calyx* 5.8–10.5 mm. long, strigulose with mixed black and white, all white, or rarely all black, straight or crisped hairs, the tube (4) 4.4–7 mm. long, (2) 2.3–3.2 mm. in diameter, the teeth subulate or subulate-setaceous, 1.4–4.2 mm. long, often crowded toward the dorsal side, the ventral sinus wide and deeply cut back, the orifice thus oblique; *petals* magenta-purple, reddish-lilac, dull blue, pale milky-white (the keel then maculate), or whitish drying creamy; *banner* 13–19.5 mm. long, 4–7 (8) mm. wide; *wings* 10.6–17.5 mm. long, the claws 5–8.3 mm., the blades 5.8–10 mm. long, 1.5–2.5 mm. wide; *keel* (8.8) 9.5–15 mm. long, the claws 4.9–8.3 mm., the blades 4.2–7 mm. long, 1.7–2.5 mm. wide; *pod* sessile or nearly so, the narrowly ovoid-, oblong-, or lance-ellipsoid body 7–12 mm. long, 2.3–3.8 mm. in diameter, densely pubescent with shorter sinuous and often some longer, straighter, mixed white and black or all white hairs; *ovules* 9–14 (16).—Collections: 340 (viii); representative: *Calder & Kukkonen* 26,781, 27,569 (NY); *Raup* 2778 (NY); *Cody* 2663 (CAS); *J. M. Macoun* 59,575 (NY); *Macoun & Herriott* 70,478 (ND, NY); *C. L. Hitchcock* 16,612, 17,922 17,961 (NY, RSA, WS); *Cronquist* 6749 (NY, RSA, SMU, WS); *Brenkle* 4317 (CAS, SMU, TEX); *Sheldon* (from Lake Christina, Minnesota) in 1892 (NY, WIS); *A. Nelson* 646 (NY, RM, WS); *Ripley & Barneby* 7981 (CAS, RSA); *Clokey* 2809 (NY, WIS, TEX); *Hitchcock & al.* 4136 (CAS, WS, WTU); *A. & R. Nelson* 2199 (NY, RM, SMU).

Plains, prairies, and dry hillsides, usually in bare rocky or gravelly places, northward on gravelly or shingly lake shores or river banks, in various soils but most abundant on sedimentary bedrock, widespread and locally abundant between 700 and 6400 feet along the east foothills of the Rocky Mountains and on the adjoining plains and prairies, from northeastern New Mexico to Alberta, and through the Peace River district into the northernmost Rocky Mountains in northeastern British Columbia, to Great Slave Lake in southwestern Mackenzie, and east (becoming less frequent) to northeastern and southwestern Manitoba, western Ontario, western (and one station in southeastern) Minnesota, and northern Iowa, in Colorado ascending westward into the higher valleys and parks up to 11,000 feet, where found on brushy hillsides, in mountain meadows, and in open pine forest; extending west of the Continental Divide to the Columbia Basin in southern British Columbia and northeastern Washington, to central Idaho, and to extreme northeastern and possibly central Utah; introduced in Yukon; reported from Kansas (Fernald, 1950, p. 911).—Map No. 77—May to August, fruiting into September northward and at great altitudes.

ASTRAGALUS ADSURGENS var. (β) ROBUSTIOR (stouter) Hook., Fl. Bor.-Amer. 1: 149, 1831.—“Common in the mountain-vallies, from the Kettle Falls to the sources of the Columbia, on the west side of the Rocky Mountains. *Douglas*.”—Holotypus, labeled “Mountain vallies and subalpine hills on the banks of Flathead River, *Douglas*,” K! presumed isotypus, labeled by Torrey “*A. adsurgens* β Hook.,” NY!—*A. nitidus* (shining) Dougl. ex Hook., l.c. in syn., nom. nud., validated by Jones in Proc. Calif. Acad. Sci. II, 5: 646. 1895.—A Douglas spm. at BM is so named, but labeled “On the Blue Mountains and near Kettle Falls, 1826.”—*A. nitidus* var. *robustior* (Hook.) Jones, Contrib. West. Bot. 10: 64. 1909. *A. adsurgens* ssp. *robustior* (Hook.) Welsh in Ia. State Jour. Sci. 37: 357. 1963.

Astragalus striatus (striate) Nutt. ex T. & G., Fl. N. Amer. 1: 330. 1838.—“Plains and hills of the Platte and Missouri . . . Nuttall.”—The sp. was based partly on *A. Laxmanni* sensu Nutt., Gen. 2: 99, non Jacqu., partly on *A. adsurgens* var. *robustior* Hook., and partly on Nuttall material from the Platte; it might best be considered a nomenclatural synonym of the preceding. A spm. labeled “*A. adsurgens*, Louisiana. Nuttall, from Lambert’s Herb.,” PH (herb. Pursh.)! is authentic for the first element; another, labeled “*Astragalus *striatus*. *A. Laxmanni* Nutt. Gen. R. Mts. Platte,” is authentic for the third.

Astragalus Hypoglottis var. *robustus* (stout) Hook. in Lond. Jour. Bot. 6: 210. 1847.—“High gravelly plains of the Upper Platte near Laramie’s Fork . . . ([Geyer] No. 126).”—Holotypus, K! isotypi, BM, G!

Astragalus sulphureus (turning sulfur-yellow, of the dried petals) Rydb. in Bull. Torr. Club 28: 36. 1901.—“COLORADO: Georgetown, 1895, P. A. Rydberg.”—Holotypus, collected August 18, 1895, NY!

Astragalus Crandallii (Charles Spencer Crandall, 1852–1929, professor of botany at Colorado State Agricultural College, 1889–1899) Gand. in Bull. Soc. Bot. France 48: xiv. 1902.—“Hab. Colorado, ad Larimer (C. S. Crandall), alt. 7–8000 ped.”—Holotypus (presumably at LY), not examined.

Astragalus adsurgens var. *pauperculus* (somewhat depauperate) Blank. in Mont. Agr. Coll. Sci. Stud. 1: 72. 1905.—“Billings, July 7, 1902 . . .”—Holotypus (presumably at MONT), not examined; apparently collected by Blankinship, and described as the opposite extreme in vigor to var. *robustior*.

Astragalus adsurgens var. *albiflorus* (white-flowered) Blank. in op. cit., p. 71. 1905.—“Field on 7-mile road, Helena, July 19, 1898, E. N. Brandegee.”—Holotypus (presumably MONT), not examined; described as the white-flowered state.

Astragalus Chandonnetii (Rev. Z. L. Chandonnet, “who works ardently and enthusiastically in the botanical field whenever season and sacerdotal duties permit”) Lunell in Amer. Midl. Nat. 2: 127. 1911.—“ . . . in dry soil at McHugh near Detroit, Minn., on June 16, 1911, by Rev. Father Z. L. Chandonnet.”—Holotypus (*Chandonnet 3135*), MINN!—*A. striatus* fma. *Chandonnetii* (Lunell) J. W. Moore in Rhodora 59: 8. 1957.

Astragalus sulphureus var. *pinicola* (living among pines) Kelso in Rhodora 39: 150. 1937.—“COLORADO: Dry hillsides in the rock pine association, Bryson’s Camp [Rocky Mountain National Park], alt. 8250 ft., August 8, 1836, L. and E. H. Kelso 319, 320 (TYPE in my collection).”—Holotypus (herb. Kelso.), not examined; isotypus (*Kelso 320*), GH!

A formidable synonymy has grown up around the common American form of the standing milk-vetch, var. *robustior*, and it remains as an index of the polymorphism encountered everywhere in *A. adsurgens*, whether in the Old or New Worlds. Apart from variation in stature and amplitude of the foliage, which can safely be attributed to accidents of environment or season, the variable features of var. *robustior* are size of the flowers, length of the calyx-teeth, color of the petals and of the hairs in the inflorescence (including the pod), and density or dispersal of the pubescence considered either separately or together. In his summary monograph Rydberg maintained three American species in the complex, stressing differential characters which for purposes of comparison and discussion may be tabulated as follows (abstracted from keys and descriptions in Rydberg, 1929, pp. 441, 449, 450).

	<u><i>A. striatus</i></u>	<u><i>A. Chandonnetii</i></u>	<u><i>A. sulphureus</i></u>
Calyx			
tube	4–6 mm.	4 mm.	4–5 mm.
teeth	3–4 mm.	3–4 mm.	as long as tube
Petals	purple rarely white	white or ochroleucous	ochroleucous
Leaflets	13–25, strigose or glabrate above	13–19, silvery-silky	11–19, glabrate
Pod	strigose	white-hairy	black-hairy

It will be seen that no significant difference was claimed for *A. Chandonnetii* other than the more silvery foliage. It represents, in fact, a series of pale- or white-flowered forms such as occur commonly in populations of bluish- or purple-flowered plants as well as in colonies of uniformly pallid hue. Color of the petals is not correlated with density of pubescence, and pale coloring of the flowers is not correlated with a white-hairy inflorescence or pod. The case of *A. sulphureus* is different, for this apparently coincides with an incipient racial differentia-

tion correlated with a range at comparatively high elevations in the Colorado Rocky Mountains. In the Front Range especially, but also farther southward, the leaflets of var. *robustior* are almost consistently glabrous above, a state unusual (though not unknown) elsewhere in the variety's range. However the glabrescent and consequently green rather than ashen herbage of the Colorado populations does not go hand in hand with pallid petals. It must be emphasized further that the petals, even in the Front Range, are not truly ochroleucous, but white when fresh, fading yellowish (as the epithet *sulphurescens* literally means) in drying. In Colorado one finds concurrently with glabrescent foliage a tendency toward relatively long calyx-teeth, but similarly long teeth are found in silvery-pubescent plants sporadically northward. The presence of black (or fuscous) hairs on the pod, mixed with white in various proportions, is a common feature of the species, but it has no racial significance and no recognizable pattern of occurrence. The Colorado material that I have seen is quite heterogeneous in the technical characters singled out for emphasis by Rydberg, and is notable finally for commonly glabrate foliage, commonly long calyx-teeth (2.6–4.2 mm.), and commonly whitish petals, but all these characteristics are seldom associated in the same plant. The var. *pinicola*, of which the petals were described as "mostly white slightly yellow after drying," supposedly differed from *A. sulphurescens* in a slightly deeper calyx-tube and erect rather than "reflexed" (meaning, I suppose, distally recurved) teeth, but is only one of several minor variants in the Colorado mountains.

The remaining synonyms of var. *robustior* have little but a historic interest. The *typus* of *A. Crandallii* has not been examined, and no duplicate has been identified as such in an American herbarium. I follow Rydberg in interpreting it as a white-flowered form of var. *robustior* similar to that described as *A. sulphurescens*. Blankinship's var. *pauperculus* corresponds with a slender or depauperate phase found occasionally in the Rocky Mountain foothills and very commonly on outcrops in the higher prairies. Relatively small flowers and short racemes are commonly but not consistently correlated with dwarf stature and narrow leaflets.

190c. *ASTRAGALUS ADSURGENS* var. *TANANAICUS*

Habit of the species, but usually low, the stems (3) 7–27 cm. long, composed usually of $\pm$ 2–5, rarely more numerous internodes; *leaves* (2) 4–10 cm. long, with (7) 11–17 leaflets (0.4) 0.7–2.5 cm. long; *peduncles* 4–12 cm. long; *racemes* 10–20-flowered, the axis 1–3.5 cm. long in fruit; *calyx* 5.6–6.8 mm. long, strigulose with black or mixed black and white hairs, the tube 4.6–5.7 mm. long, 3–3.8 mm. in diameter, the teeth 0.4–1 (2.1) mm. long; *petals* white (with lavender-purple keel-tip), or whitish tinged with slate-blue, or lavender drying bluish; *banner* 11.5–16.2 mm. long, 4.5–6.6 mm. wide; *wings* 9.7–13.8 mm. long, the claws 5–6.5 mm., the linear-oblong or -elliptic blades 5.2–8 mm. long, 1.7–2.8 mm. wide; *keel* 8.7–12.2 mm. long, the claws 5.7–6.7 mm., the blades 4.5–6 mm. long, 2.2–3 mm. wide; *pod* stipitate, the stipe 0.7–1.8 mm. long, the body narrowly oblong or oblong-elliptic in profile, 6–12 mm. long, 2.5–4 mm. in diameter, densely strigulose with short black and longer, straighter, ascending, white hairs; *ovules* (9) 12–16 (18).—Collections: 16 (o); representative: *Scamman* 4623 (GH); *A. & R. Nelson* 2165 (US); *Galen Smith* 1915, 2014 (NY); *Porsild & Breitung* 10,686 (GH); *Argus* 447a, 520 (DAO, RM); *Calder & Gillett* 24,961, 25,753 (DAO); *Calder & Kukkonen* 28,284 (DAO).

Shaley river bluffs, shingle bars, and pebbly banks of streams, in disturbed gravelly soil along highways and about airfields, or in dry grassy meadows and hillsides, common locally, 400–2500 feet, apparently confined to the Yukon River drainage in southern Yukon and eastcentral Alaska.—Map No. 77.—June to early August.

ASTRAGALUS ADSURGENS var. *TANANAICUS* (Hult.), stat. nov., based on *A. tananaicus* (of Tanana River) Hult., Fl. Alaska & Yukon 1763. 1950 ("*tananaica*"), a substitute for *A. viciifolius* (with vetchlike leaves) Hult. in Ark. Bot. 33B: 1, fig. 1. 1947 (non *A. viciaefolius* DC., 1802).—"Alaska Range distr.: Alaska Highway, mile 1247, ANDERSON 9188 (hb Hultén); Rapids Lodge, ANDERSON 2204 (Hb Hultén, type...)."—*Typus* not examined, but the photo-*typus* (Hult., l.c., fig. 1) and a *topotypus*, *Scamman* 4623, GH, are decisive.—*A. adsurgens* subsp. *viciifolius* (Hult.) Welsh in Iowa State Jour. Sci. 37: 357. 1963.

The Tanana milk-vetch was compared in the protologue with *A. agrestis* and with *A. brevidens* Rydb., and its pod was said not to be divided into two chambers. However it has all characteristics of importance in common with *A. adsurgens*, including the bilocular pod of sect. *Onobrychoidei*, and it is closely akin to the American *A. adsurgens* var. *robustior*. Flowering specimens of var. *tananaicus* can generally be separated from var. *robustior* by the short calyx-teeth, but this character sometimes fails (cf. *Viereck 1779*, COLO). During the preliminary studies of this group, I became satisfied that Hultén's species represented no more than a disjunct geographic race of var. *robustior*, one that presumably survived the Tertiary glaciations in an Alaskan refugium and had acquired with the passage of time a certain individuality of facies. At the suggestion of J. M. Calder, whose field knowledge of *Astragalus* in Yukon and British Columbia is unrivaled, I went over the material once again, discovering the short but definite stipe in the few fruiting collections available. A stipe of the same sort is known to occur in some Asiatic specimens of what I take to be characteristic var. *adsurgens*, so that the character may not be entirely stable. For the present, however, the stipe in conjunction with almost always abbreviated calyx-teeth provides a basis for distinguishing the presumably relic Alaskan var. *tananaicus* from the Cordilleran var. *robustior*. Since the disappearance of the ice sheets, the latter must have advanced northward along the Rocky Mountain piedmont to reach its northern known natural limit on the Liard River; and in recent years it has moved on as an introduction into the Yukon Valley, where it was collected along the Dawson-Whitehorse highway at 62° 50' N. (*Calder & Gillett 25,837*, NY).

The var. *tananaicus* is itself composed of two minor races. The strictly typical one, found in McKinley Park and along the Tanana River upstream from Fairbanks, has greenish leaves, a slightly tumid calyx, and whitish petals with lilac keel-tip. In the upper Yukon Valley the foliage is commonly cinereous, the calyx narrower, and the petals all pinkish-lavender drying bluish. Except for the short calyx-teeth, plants of the latter type closely resemble low prairie forms of var. *robustior*.

PHALANX D

The HYPOGLOTTIS ASTRAGALI

LV. Sectio HYPOGLOTTOIDEI

Caulescent perennials, ours with subterranean root-crown or caudex; *vesture* basifixed; *stipules*, at least at base of the stems, connate; *leaves* imparipinnate, ours with 13–31 leaflets; *flowers* densely racemose, erect and narrowly ascending in globose, ovoid, or oblong heads, of moderate or large size, the banner in ours 12.5–22 mm. long; *pedicels* persistent or subpersistent; *calyx-tube* cylindric or deeply campanulate; *petals* little incurved, regularly graduated, purple, whitish, or ochroleucous, commonly marcescent but not adnate to the staminal tube, the keel-tip obtuse; *pod* ascending to erect (or spreading because crowded), shortly stipitate or sessile, the body commonly ovoid or oblong-ovoid and triquetrous, sulcate dorsally, in an introduced sp. inflated and sulcate ventrally, bilocular, the valves thinly fleshy becoming stiffly papery or almost leathery; *dehiscence* apical, tardy; *ovules* in ours 8–22 (26).—Spp. 20 or more, of Europe and Asia, 1 widespread in eastern Asia and in western and northwestern North America, 1 sparingly introduced. Ours commonly mesophytic.

ASTRAGALUS sect. HYPOGLOTTOIDEI DC., Prod. 2: 281. 1825, pro parte, char. emend.—Sp. lectotypica: *A. Hypoglottis* L.

Cystium Stev. in Bull. Soc. Nat. Mosc. 4: 268. 1832 (& in Nouv. Mém. Soc. Nat. Mosc. 4: 107. 1834), nom. provis., validated in Bull. Soc. Nat. Mosc. 29: 147. 1856.—Sp. lectotypica (Rydb. in N. Amer. Fl. 24: 405. 1929): *C. Cicer* (L.) Stev. = *A. Cicer* L.

Astragalus subgen *Hypoglottis* sect. *Hypoglottis* Bge., Astrag. Geront. 1: 46, 50. 1868 & 2: 81 ("Euhypoglottis"). 1869.—Sp. lectotypica: *A. Hypoglottis* sensu Bge., non L. = *A. danicus* Retz.

Astragalus sect. *Hypoglottidens* Sheld. in Minn. Bot. Stud. 1: 164. 1894.—Sp. typica: *A. Hypoglottis* L.

Astragalus sect. *Hypoglottides* Jones, Rev. Astrag. 169. 1923.—Sp. typica: *A. Hypoglottis* sensu Jones, non L. = *A. danicus* Retz.

Astragalus subgen. *Hypoglottis* sect. *Eu-Hypoglottis* ser. *Ciceroides* Gontsch. in Fl. U. R. S. S. 12: 249. 1946.—Sp. manifeste typica: *A. Cicer* L.

Astragalus subgen. *Hypoglottis* sect. *Eu-Hypoglottis* ser. *Danici* Gontsch. in op. cit. 256. 1946.—Sp. typica: *A. danicus* Retz.

The sect. *Hypoglottoidei* was defined by DeCandolle in terms so loose that the original proposition is hardly serviceable in modern usage. However, once typified by *A. Hypoglottis* L. (as emended by Lacaita in Nuov. Gior. Bot. It., N. Ser., 19: No. 3. 1912) and more narrowly circumscribed, it is bound to replace the much later sect. *Hypoglottis* or *Euhypoglottis* of Bunge's monograph. The latter is itself the typical section of subgen. *Hypoglottis* Bge., a subgenus accepted by the majority of botanists in the Old World, although very likely not a phylogenetically natural group. The chief characters of the subgenus are basifixed vesture, stipules nearly always connate, a pod usually bilocular and persistent, and especially a dense, subspicate or capitate inflorescence of ascending, supposedly sessile or subsessile flowers. The pedicels of the Asiatic and American *A. agrestis*, a close ally of *A. Hypoglotti* L. and *A. danicus* Retz., are far from obsolete; I must agree with Boissier (1872, p. 208) that the subgenus is poorly characterized. The status of the subgenus lies beyond the field of this account, which is concerned with only one outlying (and one casually introduced) species. Being familiar with scarcely half the species referred by consensus of opinion to sect. *Hypoglottis* Bge., I have made no attempt at an inclusive definition of the section or at an evaluation of the subsectional divisions recognized in Flora U. R. S. S.

Since Gray's Revision (1864) to the present, *A. agrestis* (under various names) has been associated by American botanists with *A. adsurgens* var. *robustior* (or equivalents), a species with similar inflorescence but a superficial root-crown and dolabriform vesture, related to the Eurasian *A. Onobrychis*, typus of sect. *Onobrychium* Bge. (our sect. *Onobrychoidei*). These two American species represent perfectly distinct groups of which the center of speciation is found in central Asia and the near East. It is true that the two sections have so much in common that their dispersal by Bunge among separate subgenera defined simply in terms of the hair-attachment must seem more convenient than natural; but there can be no doubt whatever that sects. *Hypoglottoidei* and *Onobrychoidei* are phylogenetically natural units.

Key to the American Species of Sect. *Hypoglottoidei*

1. Stems mostly 0.5–2.5 (3) dm. long; *petals* mostly purple or purplish, if whitish or ochroleucous usually lavender-tinged when fresh; *leaflets* 13–21 (23); *pod* scarcely turgid, ovoid- or oblong-ellipsoid, subtrigonously compressed, sulcate dorsally; *ovules* 14–22; native and widely dispersed 191. *A. agrestis*
1. Stems 2.5–7 dm. long; *petals* ochroleucous, immaculate; *leaflets* 17–29 (31); *pod* inflated, ovoid or subglobose, sulcate ventrally; *ovules* 8–10; rare, introduced; cf. Appendix II, No. 2 *A. Cicer*

191. *ASTRAGALUS AGRESTIS*

Slender, low, diffuse, or erect but then weak-stemmed and commonly supported by grasses, with an oblique or vertical taproot terminating in a knotty crown or shortly, less often widely forking subterranean caudex, the stems and herbage thinly strigulose-pilosulous with fine, straight, appressed or narrowly ascending hairs up to (0.35) 0.5–0.9 mm. long, sometimes nearly glabrous, rarely cinereous when young, the leaflets either glabrous or thinly pubescent above, the inflorescence villous-pilose; *stems* usually few, (4) 8–25 (30) cm. long, simple, leafless and subterranean for a space of (0) 1–9 cm., becoming stouter on emergence, either simple thereafter, or branched just above ground, or shortly branched or spurred at 1–2 nodes preceding the first peduncle, in open places forming close, leafy tufts, in meadows or shade becoming thin and lax; *stipules* (1) 2–10 mm. long, the lowest papery-scarious or early becoming so, smaller than succeeding ones, amplexicaul and connate into a bidentate sheath, the median and upper ones commonly pallid and submembranous at base, shortly connate, but produced into erect, ovate or lanceolate, mostly obtuse, foliaceous or submembranous but greenish free blades; *leaves* 2–10 cm. long, shortly petioled, with 13–21 (23) lanceolate, oblong-elliptic, oval, or rarely linear-oblong, retuse, obtuse, or rarely (in some

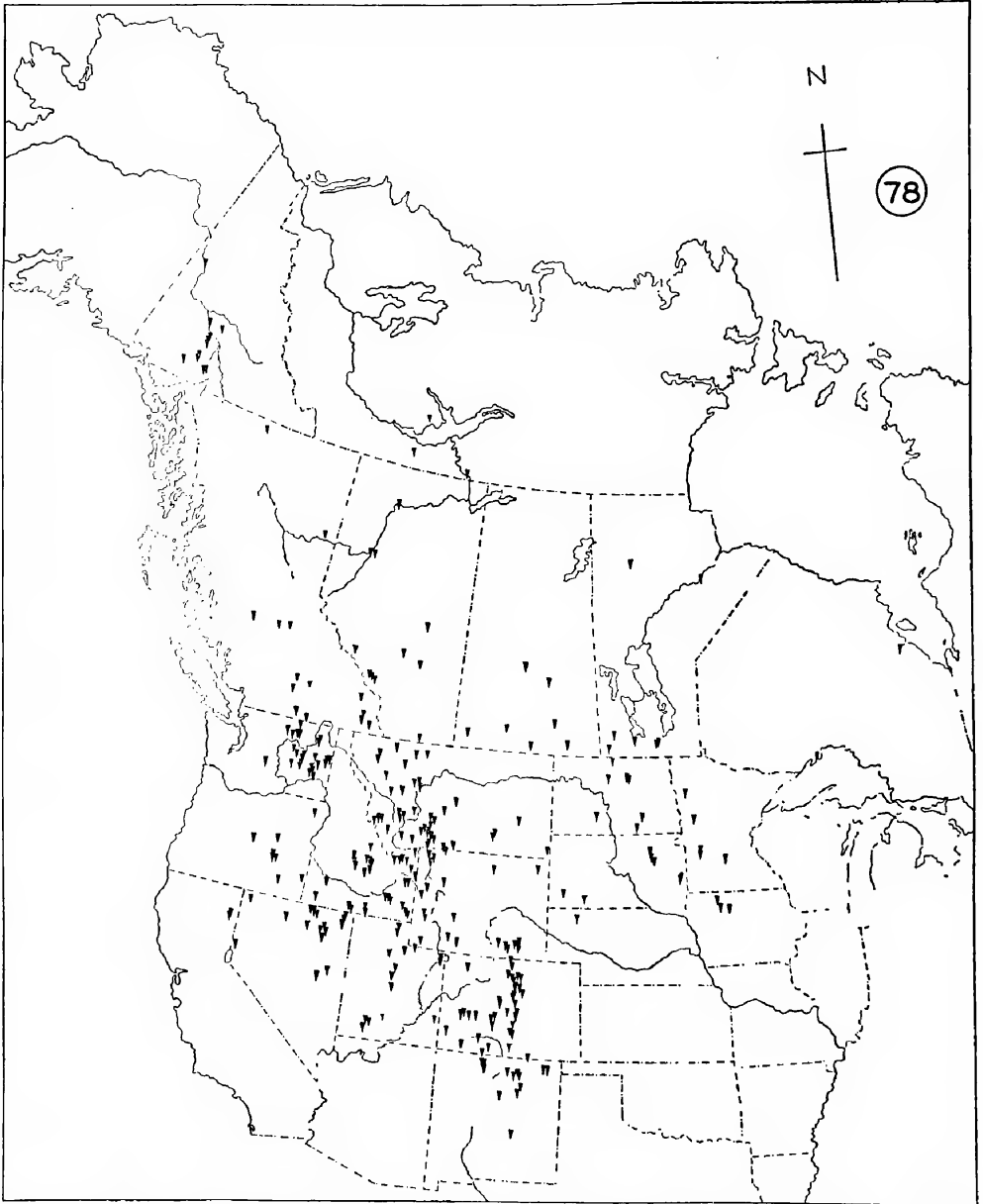
upper leaves) subacute, flat, thin- or sometimes thick-textured (and then, when dry, dorsally corrugated) leaflets 4–18 mm. long; *peduncles* relatively stout, erect or incurved-ascending, 1.5–11 cm. long, either longer or shorter than the leaf; *racemes* densely 5–15-flowered, the erect or narrowly ascending flowers crowded into an ovoid, shortly oblong, or subglobose head, the axis not or scarcely elongating, 0.5–2 (2.5) cm. long in fruit; *bracts* membranous at base but herbaceous distally, lance-, linear-oblong, or elliptic and obtuse, more rarely lanceolate and subacute, 3–7 mm. long; *pedicels* erect or ascending at a narrow angle, at anthesis 0.5–1.5 mm. long, in fruit a trifle thickened but hardly longer, persistent; *bracteoles* 0; *calyx* (7.5) 8.5–12.5 mm. long, densely or sometimes thinly villous-pilose with straight and either ascending or spreading, or spreading and curly, black and white hairs mixed in varying proportions (rarely all of either color), the subsymmetric disc 0.7–1.5 mm. deep, the cylindric or deeply campanulate, or somewhat turgid and narrowly fusiform tube 5–7.8 mm. long, 2.6–3.4 (3.8) mm. in diameter, the erect, lanceolate or linear-lanceolate, equal or unequal teeth (2.5) 3–5 mm. long, the whole becoming papery-membranous, ruptured, marcescent; *petals* magenta-purple with white or pallid wing-tips, bluish-lilac, whitish faintly lilac-tinged, more rarely ochroleucous but then nearly always suffused with dull lilac when fresh; *banner* recurved through $\pm 25^\circ$, oblanceolate, rhombic-oblanceolate or -elliptic, shallowly or deeply notched, (15) 17–22 mm. long, 5.6–8.5 (9) mm. wide; *wings* 15–18.5 mm. long, the claws 6–8 mm., the narrowly oblong or oblong-oblanceolate, obtuse or obliquely emarginate, straight or slightly incurved blades 9–12 mm. long, 1.7–2.6 (3) mm. wide; *keel* 11.4–14 mm. long, the claws 6–8 mm., the lunately half-elliptic blades 5–7 mm. long, 2.1–3 mm. wide, gently incurved through 70–90° to the bluntly triangular apex; *anthers* (0.5) 0.55–0.75 (0.8) mm. long; *pod* erect, obscurely stipitate, the glabrous stipe 0.3–1 mm. long, the body ovoid or oblong-ellipsoid, nearly straight, 7–10 mm. long, 2.8–4.5 mm. in diameter, truncate, abruptly rounded, or subcordate at base, abruptly contracted distally and cuspidate at apex, triquetrously compressed, carinate ventrally by the suture, the lateral faces flat or low-convex, the dorsal face widely but deeply sulcate, the green, thinly fleshy, at length papery valves densely silky-villous or -subtomentose above the glabrescent base with straight or curly, lustrous white hairs up to 1–2 mm. long, inflexed as a complete septum 0.8–1.4 mm. wide; *ovules* 14–22 (26); *seeds* smooth, brown, 1.2–2 mm. long. Collections: 359 (xv); representative: *Cody & Loan* 3976 (WS); *J. W. Thompson* 14,397 (CAS, WTU); *McCalla* 2135 (NY, WTU); *Macoun & Herriott* 70,492 (ND, NY), 70,493 (CAS); *C. L. Hitchcock* 17,495 (ID, NY, RSA, WS), 11,607 (CAS, NY, WS), 17,872 (ID, RSA, WS); *C. L. Porter* 4495 (NY, SMU, TEX), 5024 (SMU, TEX); *Moore & Phinney* 12,921 (NY, WS); *Ripley & Barneby* 4508 (CAS, RSA); *Eastwood & Howell* 300, 719 (CAS); *Clokey* 3077 (CAS, NY, TEX); *C. F. Baker* 457 (CAS, NY); *Ripley & Barneby* 8333 (RSA); and from Asia: *Karelin & Kirilov* 191 (NY); *Bunge* (from Altai, in 1832) misit *Fischer* (NY).

Moist meadows and prairies, stream banks, grassy pockets on sagebrush hill-sides, and cool brushy slopes, in the Great Basin sometimes on alkaline, summer-dry clay flats, ditches, and lake shores, but commonly in deep loamy soils, without apparent preference for bedrock, characteristic of low and middle elevations but ascending to 10,600 feet in the southern Rocky Mountains, widespread and common on the plains and in the foothills from central New Mexico to the upper Yukon Valley (reported of old from Alaska), west to interior Washington, Idaho, northeastern California, and the Sevier-Colorado divide in southwestern Utah, east to James Bay $\pm$ lat. 52° N. in Ontario, to southern Manitoba, western Minnesota, northern Iowa, and reported (Fernald, 1950) from Kansas; also widely dis-

persed in eastern and central Asia.—Map (in America) No. 78.—May to August, perhaps later northward.

ASTRAGALUS AGRESTIS (of fields) Dougl. ex G. Don., Gen. Hist. Dichl. Pl. 2: 258. 1832.—“Native of North America, near the Columbia River in fields.”—Holotypus, formerly in herb. Lambert., not found at BM or OXF, apparently lost, but the identity known from the following reference.—*A. Hypoglottis* β Hook., Fl. Bor.-Amer. 1: 148. 1831, where *A. agrestis* Dougl. was quoted as a synonym and the locality given as “On the fertile plains of the Red River, and on the south, towards Pembina, Douglas.”—Spm. authent., BM (dated 1827), K!

Astragalus dasyglottis (with thick tongue, the root *glottis* of ancient use in allusion to a small tonguelike pod) Fisch. ex DC., Prod. 2: 282. 1825.—“in Sibiria altaica . . .”—Holotypus,



Map No. 78. Parts of western Canada and United States. Range (in America) of *A. agrestis*.

labeled "Altai. *Mardofkin*. Radix repens. Misit Fischer.," G-DC!—Non *A. dasyglottis* Pall., Astrag. 105. 1800—*A. Hypoglottis* β *dasyglottis* (Fisch.) Ledeb., Fl. Alt. 3: 293. 1831.

Astragalus goniatus (angled, of the stem) Nutt. ex T. & G., Fl. N. Amer. 1: 330. 1838.—"Rocky Mountains, near the sources of the Platte."—No spm. found in herb. Nutt., BM; isotypi, labeled by Nuttall "*Astragalus *goniatus*. R. Mts. N. Cal.," K, NY!

Astragalus Hypoglottis β ? *polyspermus* (many-seeded) T. & G., Fl. N. Amer. 1: 329. 1838.—"On the Platte, and near the sources of the Canadian, Nuttall! Dr. James!"—Cotypi, labeled respectively: "*A. dasyglottis* Ledeb. Platte. R. Mts. Nuttall. β of *Hypoglottis*." and "On the Platte, Dr. James. *A. Hypoglottis* β ," NY! probable isotypus in herb. Pursh., labeled "*A. Hypoglottis*. from Lambert's Herb. Nuttall.," PH!—*A. agrestis* var. *polyspermus* (T. & G.) Jones, Contrib. West. Bot. 10: 65. 1902.

Astragalus virgultulus (of somewhat shrubby form) Sheld. in Minn. Bot. Stud. 1: 165. 1894.—"On the plains near Boulder, Colorado, H. N. Patterson, July 1892."—Holotypus, *Patterson 181*, MINN! isotypus, NY!—*A. agrestis* fma. *virgultulus* (Sheld.) Boivin in Nat. Canad. 87: 28. 1960.

Astragalus Hypoglottis var. *bracteatus* (with large bracts) Osterh. in Bull. Torr. Club 26: 256. 1899.—"Collected in July, 1896, and again in 1898 along the Laramie River in Wyoming about one half mile north of Colorado."—Holotypus, *Osterhout 1781*, collected July 21, 1896, RM (2 sheets)! paratypi, collected July 14, 1896, NY, RM, WIS!—*A. agrestis* var. *bracteatus* (Osterh.) Jones, Contrib. West. Bot. 10: 87. 1902.

Astragalus Tarletonis (John Berry Tarleton, b. 1849, architect, visited Yukon in 1899) Rydb. in Bull. N. Y. Bot. Gard. 2: 175. 1901.—"The type was collected by J. B. Tarleton at Five-Finger Rapids, July 5, 1899 (No. 78)."—Holotypus, NY! isotypus, US!

In its American range the field milk-vetch, *A. agrestis*, is catholic in its choice of habitat, its one apparent necessity being plentiful moisture at the root during the period of active growth. It is found most commonly in low-lying meadows, on damp prairies, or along grassy stream banks where it is obliged to compete with other plants and tends to become relatively tall, erect, and weak-stemmed, with ample thin-textured foliage, and with peduncles surpassing the subtending leaf. Here and there, but with increasing frequency westward and southward from Montana, the plants are equally at home in more open places such as depressions on basalt plains, along roadside ditches where winter rain collects and settles, or on the margins of summer-dry lakes. In these and comparable sites the individual is generally of lower and more compact growth, sometimes truly dwarfed in strongly alkaline soils, while the peduncles become shorter and the leaflets smaller and of thicker texture. These, however, are no more than individual variants subject to environmental conditioning, and the flowers vary within the same size-limits irrespective of the plant's stature. The color of the petals and of the calyx-hairs, and the length of the bracts, stipules, and calyx-teeth are all variable features in *A. agrestis*, but they are nowhere correlated and fail severally to conform with any recognizable pattern of dispersal. It is therefore not possible to maintain such segregates as *A. Tarletonis*, *A. agrestis* (sens. restr.), or *A. virgultulus*, supposedly distinguished by combinations of these characters.

The field milk-vetch is taxonomically isolated in our flora, but has several close relatives in Eurasia, notably *A. danicus* Retz. (= *A. Hypoglottis* auct., non L. emend. Lacaita). The latter closely resembles *A. agrestis* in habit of growth and in most fine details; but whereas the villous-pilose inflorescence of our plant contrasts with foliage merely strigulose or glabrescent, the leaves of *A. danicus* are thinly pilose with spreading or ascending hairs while the calyces are strigulose. Bracts, stipules, and calyx-teeth all are shorter on the average in *A. danicus*, but these seemingly separate features tend to vary together as though controlled by a common genic mechanism and thus constitute only one, and that an unimportant differential character. The range of *A. danicus* extends from western Europe into central Asia, where it overlaps that of *A. agrestis* to some extent, and there are indications of intergradation between the two in Altai. Very possibly Ledebour's disposition of *A. dasyglottis* Fisch. as a variety of *A. danicus* (as *A. Hypoglottis*) will be confirmed.

The history of *A. agrestis* goes back to the earliest botanical explorers of western North America. Although it was unknown to Pursh in 1814, by 1838, the date of Torrey & Gray's Flora, it had been collected by Douglas in Washington and Manitoba, by Drummond in Alberta, by Nuttall in Wyoming, and by Dr. James on the South Platte. These and other early gatherings were identified by Hooker, Gray, and Torrey as *A. Hypoglottis* or referred to a var. *polyspermus*, so named because the several-ovulate pod was believed to differ from that of European *A. Hypoglottis*, described erroneously by DeCandolle as two-seeded. Nuttall had recognized one of his own collections as *A. dasyglottis* and described another as *A. goniatus*, but these attempts to differentiate between superficially disparate forms were carried no further until many decades later. In Gray's Revision (1864, p. 197) only a single, supposedly circum-boreal "*A. Hypoglottis*" is recognized. Jones appreciated the differences between the European

species and ours, for which he adopted (1923, p. 170) the long-forgotten *A. agrestis* Dougl. ex G. Don, a name which has remained intermittently current since. The first modern reference to the presence of the Asiatic species known as *A. dasyglottis* (of Fischer, not of Pallas) is apparently that of Gontscharov (1946, p. 258). A commentary on its history and bicentric dispersal has been published elsewhere (Barneby in Leaflet West. Bot. 9: 49. 1959), but it has been discovered since that the name *A. dasyglottis* taken up for the species common to Asia and America is a later homonym. The first *A. dasyglottis* dates back to Pallas's monograph of 1800 and was a deliberate and even at the time illegal substitute for *A. pentaglottis* L. (= *A. echinatus* Murr.), to which Pallas subordinated *A. Hypoglottis* L. (probably meaning *A. danicus* Retz., not *A. purpureus* Lamk.) as a variety. Since *A. dasyglottis* Pall. was palpably superfluous and taxonomically indefensible from birth, it was passed over by DeCandolle (Prod. 2: 1825) when he came to publish *A. dasyglottis* Fisch. The Pallas name was taken up by Steudel (Nomencl., Ed. 2, 1: 160. 1840) as a synonym of *A. pentaglottis*, and is so quoted by *Index Kewensis*, thereby escaping the serious attention of modern authors (including Gontscharov and Barneby). It seems possible that the name *A. dasyglottis*, as used by Fischer on the label which reached DeCandolle and which passed into the literature through the pages of the *Prodromus*, was a sensu-name, not intended by Fischer as a proposition independent of *A. dasyglottis* Pall., even though it was so interpreted by DeCandolle. As mentioned already, Pallas construed *A. Hypoglottis* L. as a variety of his own *A. dasyglottis*, and a specimen of either species might easily have been distributed under the latter name.

So far as I have seen it in the field, *A. agrestis* is not a weedy astragalus, although sometimes found along ditches where it encounters the moist conditions needed for successful growth. However it has been reported as adventive in Boone County, Illinois (near Belvidere, Jones & Fuller, Vasc. Pl. Ill. 273. 1956), and some of the outlying stations on record may have been opened up to the species by man-made changes in environment. Prof. C. L. Porter tells me that in the Rocky Mountains the flowers of *A. agrestis* are agreeably fragrant. In water meadows of western United States the plants are often browsed, but I have no report of *A. agrestis* as a loco-weed.

PHALANX E

The PIPTOLOBOID ASTRAGALI

LVI. Sectio ARGOPHYLLI

Low, tap-rooted perennials, sometimes flowering the first season, either acaulescent and tufted or matted, or caulescent, the stems then prostrate or diffuse; *root-crown* or caudex superficial or aerial; *vesture* either basifixed or dolabriform; *stipules* free (the lowest connate in an anomalous form of *A. missouriensis*, sometimes also in *A. tephrodes* and *A. zionis*); *leaves* imparipinnate, sometimes only 3–5-foliate; *peduncles* decumbent in age, the fruits humistrate; *flowers* subcapitate or racemose, ascending (reflexed only in *A. neomexicanus*); *calyx-tube* cylindrical or deeply campanulate, rarely campanulate; *petals* varicolored; *keel-tip* obtuse; *pod* sessile, readily deciduous (except in *A. missouriensis* and *A. accumbens*), varying in outline from subglobular to elliptic or narrowly lanceolate, straight or commonly incurved, usually dorsiventrally compressed below the beak, in a few spp. laterally compressed, uni- or bilocular, the $\pm$ fleshy valves becoming thinly leathery to woody or sometimes alveolate-spongy (exceptionally papery) when ripe; *dehiscence* mostly apical, after falling, more specialized in some spp.; *ovules* (8) 11–70.—Spp. 36, xerophytes (a mesophytic var. in *A. argophyllus*), widespread in western United States and extending just into northern Mexico and southwestern Canada (southern British Columbia to Saskatchewan, northern Baja California, northern Sonora, and western Texas), abundant throughout the intermountain region, especially well developed in the Great Basin and Colorado Plateau.

The sect. *Argophylli*, one of the largest groups of North American *Astragali*, has been built up by accretion around the dual nucleus of Gray's *Argophylli* and *Eriocarpus*. As most recently defined (Barneby, 1947), it consisted of twenty-seven species and was essentially

homogeneous, particularly in the form of the flower and, with the single exception of *A. leucolobus*, in the unilocular pod. It now seems both expedient and proper to admit several marginal species with bilocular pods, which appear to be recently and directly derived from unilocular *Argophylli* in the same way that *A. leucolobus* must surely have been derived from *A. Purshii*. The alternative to such expansion of sect. *Argophylli* is to assign these bilocular forms to independent sections of one or two species apiece. It seems natural, furthermore, to bring in two rare and highly localized species, *A. accumbens* and *A. musimonum*, in which the calyx-tube has become shortened and relatively broader than in the prototypical *Argophylli*, and the petals have become relatively broader and shorter-clawed in consequence. These represent evidently recent modifications stemming from *A. missouriensis* and *A. amphioxys*, respectively. Each is known from a single point on the western periphery of the wide range of its common relative. Lastly *A. neomexicanus*, peculiar in its reflexed flowers and dorsally gibbous calyx-tube, but habitally similar to some forms of *A. tephrodes* and essentially like it in structure of the fruit, has been introduced in a monotypic subsection, for it has no apparent kinship elsewhere in the genus.

The additions already mentioned, together with a few recently or here newly described species, have raised the total of known *Argophylli* to thirty-six, and have introduced so great a variety of modifications in the flowers and fruits as to render the section at least superficially heterogeneous. It now contains critical and taxonomically difficult subgroups of closely interrelated species and almost as many extremely well-marked or even isolated ones. The morphological discontinuities between the nine subsections recognized below are sometimes of no great width, but assume their importance only as seen in the context of the section as a whole.

The *Argophylli*, together with the next six sections, constitute one of the three principal divisions of the North American piptoloboid *Astragali*. Ignoring for the moment the rather numerous exceptions, I find the following features common to this large assemblage of forms: free stipules; relatively long, narrow, ascending flowers with an oblanceolate or rhombic-oblanceolate, moderately recurved banner; and large, nearly always fleshy or succulent, commonly humistrate fruits which disjoint when ripe and dehisce by apical fracture on the ground.

Key to the Subsections of Sect. *Argophylli*

1. Pubescence of the leaves composed entirely of basifixed hairs (2)
2. Petals purple, pink, white, or ochroleucous, not over 3 cm. long, distinctly and often strongly graduated, the keel in any case much shorter than the banner; banner recurved through $\pm 45^\circ$; keel-blades half-obovate or -oblanceolate, strongly asymmetric (3)
3. Pubescence of the leaves various, composed either of straight, appressed or narrowly ascending, or of spreading-incurved and sometimes sinuous or contorted hairs, but not of extremely fine, entangled hairs, never entirely cottony-tomentose; pod strigulose, glabrous, villosulous, simply lustrous-hirsute (in *A. eurekaensis* and *A. callithrix*), or both villous-hirsute and tomentose (in *A. marianus* and *A. Newberryi*) (4)
4. Flowers ascending at anthesis; calyx subsymmetric or moderately oblique at base, never gibbous behind the pedicel; plants normally spring-flowering; dispersal not as in the next (5)
5. Plants either caulescent or acaulescent, but if the latter then the leaflets more than 11 in some leaves, or the flowers more than 8 in some racemes, or both; normally caulescent if the pod densely villous-hirsute (6)
6. Stipules very large and conspicuous, ovate, mostly broader than the stem, imbricated; flowers relatively small, the keel 7–12.5 mm. long; rare species of rock ledges and rimrock pavement in the sandstone mesa country of the Colorado Basin; cf. Sect. *Desperati*.
6. Stipules not very large and conspicuous, hardly or not as broad as the stem (cf. *A. zionis*); if on sandstone of the Colorado Basin the flowers much larger, the keel 14.5–18.5 mm. long; widespread (7)
7. Pod unilocular; widespread (8)
8. Calyx-tube deeply campanulate or cylindric, mostly over 7 mm. long, but if shorter then the teeth less than half as long; petals purple or purplish, sometimes pale; widespread, but only one sp., *A. Shortianus*, sympatric with the next, and that both acaulescent and with appressed-silky leaflets LVI (i). *Argophylli*
8. Calyx-tube campanulate, sometimes deeply so, ± 5 –7 mm. long, the teeth more than half as long; petals commonly white, sometimes

veined or suffused with rose; *stems* and herbage hirsute; caulescent plants of the e. slope of the s. Rocky Mountains (just w. to the head of the Grand River) in Wyoming and Colorado _____

- LVI (vii). *Parryani*
 7. Pod bilocular; w. Texas to centr. New Mexico _____ LVI (ii). *Pseudargophylli*
 5. Plants strictly and obligately acaulescent; either the leaflets 3–11, or the racemes 1–6-flowered, usually both (but the leaflets sometimes to 17 and flowers to 8 in *A. Newberryi* which has densely hirsute and tomentose pods); plants of intermountain United States, extending feebly s.-e. to the Rio Grande in n. New Mexico _____ LVI (iv). *Newberryani*
 4. Flowers reflexed at anthesis; *calyx-tube* gibbous at base behind the pedicel; robust caulescent plants of the White and Sacramento Mountains, New Mexico, flowering in late summer and fall _____ LVI (iii). *Neomexicanani*
 3. Pubescence of the leaves (and commonly of the entire plant) softly villous-tomentose or pannose, composed of extremely fine, cottony, contorted or entangled hairs; *pod* both villous-tomentose and hirsute, or simply hirsute (in *A. nudisiliquus*), or simply villous-tomentose or -tomentulose (in *A. leucolobus* and *A. subvestitus*) _____ LVI (vi). *Eriocarpia*
 2. Petals scarlet, the banner and keel of nearly equal length, 3.5–4 cm. long, the banner little recurved, the keel-blades subsymmetrically oblanceolate; desert-bordering mountains of s.-e. California, extreme n. Baja California, and s.-w. Arizona _____ LVI (v). *Coccineii*
 1. Pubescence of the leaves composed entirely or in great part of dolabriform hairs (9)
 9. Either the leaflets 3–5, or the pod hirsute with lustrous, spreading hairs up to 2 mm. long _____ LVI (iv). *Newberryani*
 9. Leaflets mostly more numerous, except in seedling plants or in some early leaves; *pod* strigulose (10)
 10. Pod variable in shape but always distinctly beaked, unilocular or almost so, the septum 0 or very narrow and obscure, scarcely over 1 mm. wide _____ LVI (viii). *Missourienses*
 10. Pod plumply oblong-obovoid or globose, minutely cuspidate but not or scarcely beaked at apex, fully bilocular, the septum complete, 3–6 mm. broad; Gunnison County, Colorado _____ LVI (ix). *Anisi*

LVI (i). Subsectio ARGOPHYLLI

Either caulescent or acaulescent; *pubescence* basifixed, strigose or villosulous, never cottony-tomentose; *stipules* semiamplexicaul or fully so, free (but cf. *A. tephrodes* and *A. zionis*); *flowers* subumbellate or shortly but often loosely racemose, of large or medium size, the banner 11.5–26 mm. long; *petals* purplish or purple, sometimes pallid and lilac-tinged; *pod* ovoid-, oblong-, or lance-ellipsoid, straight or strongly incurved, distally contracted into a laterally compressed beak, the $\pm$ fleshy valves becoming leathery or woody, glabrous, strigulose, hirsute, or densely villous-tomentose; *septum* 0, or very narrow and obscure; *dehiscence* apical, the beak gaping to release the seeds, the exocarpic sutures sometimes splitting lengthwise but the valves not separating; *ovules* 24–54 (66).—Spp. 11, widespread over the intermontane United States and southern Rocky Mountains (southwestern Montana, western Wyoming, and southern Idaho, southward), south to the Mohave Desert, California, the Gila Basin in Arizona and adjoining Sonora, and the Rio Grande Valley in New Mexico; 1 isolated in the Columbia Basin, interior Washington.

ASTRAGALUS sect. ARGOPHYLLI Gray in Proc. Amer. Acad. 6: 209. 1864, sens. str.—Sp. lectotypica: *A. glareosus* sensu Gray, l.c., non Dougl. = *A. argophyllus* Nutt.—*Astragalus* sect. *Sericophyllus* Sheld. in Minn. Bot. Stud. 1: 146. 1894, a superfluous substitute. *Astragalus* sect. *Argophylli* subsect. "*Argophylli* proper" Jones, Rev. Astrag. 199, in clave. 1923.

Xylophacos Rydb. ap. Small, Fl. S. E. U. S. 619, 1332. 1903.—Generitypus: *X. Shortianus* (Nutt.) Rydb. = *A. Shortianus* Nutt.—*Astragalus* subgen. *Xylophacos* (Rydb.) Tidest. in Contrib. U.S. Nat. Herb. 25: 319. 1925.

Xylophacos sect. *Cyanei* Rydb. in Bull. Torr. Club 52: 144. 1925.—Sp. typica: *X. cyaneus* (Gray) Rydb. = *A. cyaneus* Gray.

Key to the Species of Subsect. Argophylli

1. Leaflets not more than 21 in any leaves (2)
 2. Ovary and pod glabrous; strongly caulescent plants of the floor of the Columbia Basin, thinly strigulose, with very short peduncles 1–2.5 cm. long arising from axils at or below the middle of the diffuse stems _____ 201. *A. columbianus*
 2. Ovary and pod pubescent; s. Idaho and s.-w. Montana s.-ward (3)
 3. Pod strigulose or villosulous, rarely villous with incurved or contorted hairs, but these not over 1.65 mm. long (4)
 4. Pod laterally compressed at both ends, obcompressed at the middle, mostly 2–5.5 cm. long, crescentic or coiled into a ring, not mottled; plants of the Mohave Desert in San Bernardino County, California, and s. Clark County, Nevada, with densely villous-hirsute stems and coarsely villous-tomentose herbage _____ 202. *A. Tidestromii*
 4. Pod dorsiventrally compressed from the base up to the laterally compressed beak (if somewhat laterally compressed proximally then shorter and brightly mottled); range otherwise (5)
 5. Pod ordinarily very large, (2) 2.5–4.5 cm. long, (8) 9–18 mm. in diameter; plants of the e. slope of the Rocky Mountains from w. Wyoming s. through Colorado (where extending w. just to the head of Grand River) to the upper Rio Grande Valley in New Mexico; *calyx* villous, its vesture contrasting with that of the silvery-strigose herbage _____ 199. *A. Shortianus*
 5. Pod ordinarily shorter and narrower, 1.5–3.2 cm. long, 5–12 mm. in diameter; plants of the w. slope of the Rocky Mountains and of the intermountain U. S. (extending e. to the upper Wind River in Wyoming and to s.-w. Montana); *vesture* of the *calyx* and herbage commonly uniform or nearly so (6)
 6. Peduncles mostly longer than the leaves (cf. *A. tephrodes* var. *brachylobus* in n. Arizona)
 6. Peduncles shorter than the longer leaves (7)
 7. Pod (at least beneath the vesture) green turning brown or stramineous, not or scarcely sulcate ventrally; widespread, and extending s. into the range of the next, but there found mostly in the pine belt _____ 192. *A. argophyllus*
 7. Pod brightly red-mottled, ventrally sulcate toward the base; plants of rock ledges and talus of sandstone canyons or escarpments in Washington, Kane, and San Juan Counties, Utah, and adjoining n. Arizona _____ 193. *A. zionis*
 3. Pod either simply hirsute with lustrous hairs, or both hirsute and tomentose, but the longest hairs (1.7) 2–3.5 mm. long. Local species of e.-centr. Nevada and of w. and centr. Utah (8)
 8. Valves of the pod simply hirsute with lustrous hairs and these not concealing the surface; plants of valley dunes in n.-e. Nye County, Nevada _____ 196. *A. callithrix*
 8. Valves of the pod both shaggy-hirsute and tomentose, the vesture almost or quite concealing the surface; plants of gravelly hillsides and of pine forest, Lincoln and White Pine Counties, Nevada, to w. and centr. Utah (9)
 9. Vesture of the leaflets appressed or nearly so; *petals* not very strongly graduated, the banner 17–21 and keel 15–19 mm. long; *pod* 2–3.5 cm. long; *ovules* 27–36; e. Nevada and w. Utah, not uncommon _____ 194. *A. marianus*
 9. Vesture of the leaflets mostly ascending; *petals* strongly graduated, the banner 18–22.5, the keel 12–13.5 mm. long; *pod* about 1–1.2 cm. long; *ovules* 14–16; San Pete County, centr. Utah _____ 195. *A. desereticus*
 1. Leaflets (except in some seedling plants) over 21 in some mature leaves (10)
 10. Ovary and pod glabrous; *calyx* loosely villous-villosulous; plants of s.-w. Colorado and n.-w. New Mexico _____ 198. *A. iodopetalus*
 10. Ovary and pod strigulose or villosulous (if, exceptionally, in Arizona, glabrous, then the *calyx* strigulose) (11)
 11. Pod very large, 2.5–5 cm. long, 7–13 mm. in diameter, thickly fleshy, the ripe valves woody and 1–2 mm. thick; *ovules* (35) 39–48; *herbage* strigulose; local in the upper Rio Grande Valley between Taos and Albuquerque, New Mexico _____ 200. *A. cyaneus*
 11. Pod commonly smaller, variable in texture, but the valves less than 1 mm. thick when ripe; *ovules* 24–36; s.-centr. and w. New Mexico, n. Sonora, and

w. through Arizona to extreme s. California, s.-w. Utah, and s. Nevada. Pod up to 4 cm. long and up to 1.6 cm. in diameter, and ovules 34-45 in var. *eurylobus* of s.-e. Nevada, but the herbage then canescently pilosulous

197. *A. tephrodes*

192. *ASTRAGALUS ARGOPHYLLUS*

Acaulescent or shortly caulescent, densely pilose or strigose throughout with appressed to narrowly or loosely ascending, straight, or sometimes partly sinuous hairs up to (0.65) 1-1.65 mm. long, the herbage silvery-silky, or somewhat greenish in age; *stems* 0-1 (1.5) dm. long, when developed prostrate and radiating, the internodes all short, rarely up to 2 cm. long, usually little longer or all shorter than the loosely imbricated stipules; *stipules* submembranous becoming papery, often brownish when old, 2-8 (10) mm. long, the lowest (often dorsally glabrate) and sometimes all ovate or broadly lanceolate, the upper ones commonly longer and narrower, decurrent-amplexicaul around half to the whole stem's circumference, but the margins, even when in contact, not united; *leaves* 1.5-12 (15) cm. long, those subtending the peduncles sometimes much longer than the rest, all slender-petioled, with 7-21 rhombic-elliptic, oval-oblanceolate, or obovate-cuneate, acute or obtuse, distant or crowded, flat or loosely folded leaflets 2-15 mm. long; *peduncles* almost 0 to 9 cm. long, usually much and always a little shorter than the leaf, incurved-ascending at anthesis, arcuately reclinate or prostrate in fruit; *bracts* membranous or broadly membranous-margined, ovate or lanceolate, 1.8-6.5 mm. long; *pedicels* ascending or a trifle arched outward, at anthesis slender, 1.2-3.2 mm. long, in fruit a little thickened, 1.8-3.8 mm. long; *bracteoles* commonly 0, exceptionally present and up to 2.5 mm. long; *calyx* 9-16.8 mm. long, pubescent like the herbage with white and often some or nearly all black hairs, the somewhat oblique disc 1-2.5 mm. deep, the cylindric, pallid or purplish tube 6.5-11.8 mm. long, 2.8-4.6 mm. in diameter, the subulate or linear-subulate teeth 1.6-5 (5.8) mm. long, the whole becoming papery, ruptured, marcescent; *petals* either bright pink-purple (drying bluish), or tinged with lilac or dull purple; *banner* oblanceolate, broadly rhombic-oblanceolate, or spatulate, notched, 15-24 mm. long; *wings* a little shorter, the lance-oblong, obtuse blades rather abruptly narrowed and usually a little incurved in the distal third; *keel* 12.1-20.3 mm. long, the half-obovate or lunately elliptic blades 4.6-7.4 mm. long, gently incurved through 80-90 (95)° to the blunt apex; *anthers* 0.45-0.85 mm. long; *pod* ascending (humistrate), varying from plumply ovoid-acuminate to narrowly lance-elliptic in profile, 1.5-3.2 (3.7) cm. long, 5-12 (13) mm. in diameter, either straight proximally and incurved into the deltoid or triangular-acuminate, laterally compressed beak, or gently incurved (through up to ½-circle) its whole length, obcompressed and dorsally flattened or very shallowly and widely sulcate in the lower ⅔, the ventral suture thick and prominent but sometimes depressed and lying in a double groove, the ± fleshy, green valves becoming brownish, stiffly leathery or woody, faintly to quite strongly rugulose-reticulate and sometimes also wrinkled lengthwise on the ventral side, thinly to densely strigulose or sometimes villous-villosulous, not inflexed; *dehiscence* apical, the ventral suture finally splitting but not separating; *ovules* 25-43; *seeds* brown, smooth or sparsely pitted, dull, 1.7-3 mm. long.

The silver-leaved milk-vetch, the species nomenclaturally typical of its section, is also by some happy chance the one which seems most nearly to represent a generalized prototype of the *Argophylli*. From *A. argophyllus* var. *Martini* it is possible to follow through several lines of modification involving small and sometimes parallel steps the probable course of evolution which has culminated in the more specialized forms. Being morphologically central to the section and serving as a point of contact (either directly or through its closest kindred) between subsections *Eriocarp*i and *Newberryani* (which lead on toward the more aberrant or peripheral groups), *A. argophyllus* might be thought directly ancestral to the remaining *Argophylli*. The

species is, however, highly polymorphic and variable, characteristics which are seldom associated with age or a primitive condition.

The geographic races of *A. argophyllus* vary considerably in orientation of the vesture, in size and color of the flowers, and in ecology. It is only with difficulty that the material may be sorted into three main categories, and even if these pretty clearly correspond with real divergent lines of development, individual plants will surely be met with which cannot be placed satisfactorily by use of the following key.

Key to the Varieties of *A. argophyllus*

1. Flowers large, the banner 18.2–24 mm. long, the keel 15.9–20.3 mm. long; *pod* plumply ovoid to broadly lance- or oblong-ellipsoid, mostly 2–3 times as long as its greatest diameter, the valves variably pubescent, but not permanently silky-strigose in age (2)
2. Petals bright purple, the ample banner 22–24 mm. long, 9–13.7 mm. wide; *plants* of moist meadows, stream banks, or lake shores 192a. var. *argophyllus*
2. Petals merely tinged with lilac or dull purple, the banner mostly shorter and narrower, 18–21.5 (22.5) mm. long, 7–9.4 mm. in diameter; *plants* of dry gravelly hills and mesas, often among sagebrush 192b. var. *Martini*
1. Flowers smaller, the banner 15–17.5 (18.4) mm. long, in n. Arizona rarely up to 23.4 mm. long, the keel 12–15.2 mm. (in Arizona up to 19.8 mm.) long; *pod* mostly narrower, lunately ellipsoid, 3–4 times as long as its greatest diameter, densely and permanently silky with subcontiguous, appressed hairs; mountains of s.-centr. Utah and n. Arizona 192c. var. *panguicensis*

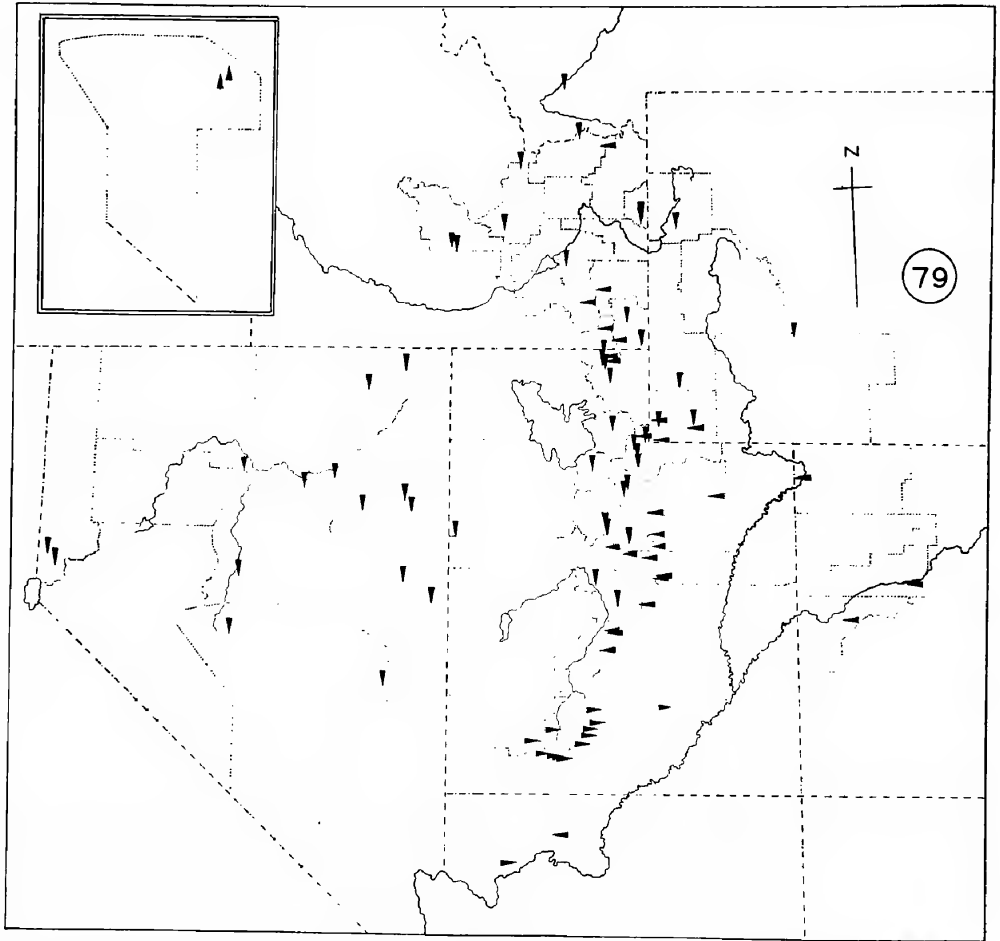
192a. *ASTRAGALUS ARGOPHYLLUS* var. *ARGOPHYLLUS*

Root and caudex stout, tough, heavy; *hairs* of the herbage either all appressed or mostly narrowly ascending, straight or nearly so, up to (0.75) 1–1.65 mm. long; *stems* almost 0 up to 1 (1.5) dm. long; *leaves* (1.5) 2.5–12 (15) cm. long, with (7) 9–21 commonly elliptic, rhombic-elliptic, or -ovate and acute, more rarely oval-oblongate and obtuse, usually distant but sometimes crowded leaflets (2) 4–15 mm. long; *calyx* 12.4–16.8 mm. long, the tube (9.4) 10–11.8 mm. long, 3.4–4.6 mm. in diameter, the teeth 2.4–5 (5.8) mm. long; *wings* 20.6–23.8 mm. long, the claws 11.6–14.2 mm., the blades 9.2–12.2 mm. long, 2.1–3.5 mm. wide; *keel* (17.3) 17.6–20.3 mm. long, the claws 11.6–14.2 mm., the blades 6.1–7.4 mm. long, 2.7–3.4 mm. wide; *pod* 1.5–2.5 cm. long, 7–12 mm. in diameter, strigulose-pilosulous with straight, appressed or subappressed hairs up to (0.35) 0.5–1 mm. long.—Collections: 53 (ix); representative: *Macbride & Payson 3020* (CAS, NY, POM); *Jones 3833* (CAS, GH, NY, POM, TEX); *Ripley & Barneby 4509, 5930, 6168* (all CAS, RSA); *Goodding 1090* (NY, POM); *Eastwood & Howell 496* (CAS, POM).

Alkaline and saline meadows, moist at least in spring, stream banks and lake shores, in stiff alluvial clays and loams, sometimes in damp crevices about hot springs, 4500–7650 feet, scattered but locally abundant, central and northwestern Nevada north and eastward across the Snake River Plains to the upper forks of the Salmon River in Idaho, extreme southwestern Montana, the upper Wind River, Wyoming, and the San Pitch River in central Utah.—Map No. 79.—May to July.

ASTRAGALUS ARGOPHYLLUS (silver-leaved) Nutt. ex T. & G., Fl. N. Amer. 1: 331. 1838.—“Vallies of the Rocky Mountains, near the sources of the Platte, *Nuttall!*”—Holotypus, labeled “*Astragalus *argophyllus*. R. Mts., Columbia slope.” BM! isotypi, GH, NY, P!—*Xylophacos argophyllus* (Nutt.) Rydb. in Bull. Torr. Club 40: 49. 1913. *Astragalus argophyllus* var. *typicus* Barneby in Amer. Midl. Nat. 37: 458. 1947.

Xylophacos uintensis (Jones) Rydb. in Bull. Torr. Club 32: 662. 1905, based on *Astragalus uintensis* (of the Uintah Mountains, an epithet proposed in the belief that the species concerned either was the same as *A. Chamaeleuce* Gray, originally from, supposedly, the n. slopes of the Uintahs, or, if not, required a new but in that case inappropriate name) Jones in Proc. Calif. Acad. Sci. II, 5: 670. 1895 (“*Uintensis*”) nom. provis., this based in turn, at least in part, on *A. Chamaeleuce* sensu Jones in Zöe 3: 294. 1893, non Gray.—“... always grows in firm damp meadows...” —Lectotypus (Barneby, 1947, p. 459): Salt Lake Valley, *Jones in 1880, POM!*



Map No. 79. Utah, Nevada, and parts of adjoining states. Range of *A. argophyllus*: $\blacktriangle$ *var. argophyllus*; $\blacklozenge$ *var. Martini*; and $\blacktriangledown$ *var. panguicensis*. Inset, Nye County, Nevada. Range of *A. uncialis*.

The silver-leaved milk-vetch is one of the few astragali of the intermountain region and the only one with large, purple flowers and silvery-silky leaflets that is confined to moist heavy soils, where it is subject to competition with sod-forming grasses, sedges, and other relatively rank herbaceous growth. The plants spring into flower with the year's first warm weather, along with *Carex Douglasii* and *Dodecatheon radicum*, and at anthesis form handsome ground-hugging mats or low tufts of silvery foliage seated on an extremely tough, woody root. The root and caudex, difficult to collect, are seen seldom in herbarium specimens. As the season advances and the surrounding turf grows up into the hay of summer, the plants are hidden from ready view and the green, fleshy, humistrate ovaries ripen slowly, in concealment, into the straw-colored or ultimately blackish, readily deciduous pods. The leaf-rachis in *var. argophyllus* is comparatively slender and flaccid, the leaflets tending to be small, distant, and diamond-shaped. Dried material does little justice to the brilliance of the fresh flower, which dries out rapidly from a lively pink-purple to a dull slate-blue, an effect attributed by Jones to the alkalinity of the drying papers. However the chemistry of the sap and pigment has still to be investigated.

192b. *ASTRAGALUS ARGOPHYLLUS* *var. MARTINI*

Similar to *var. argophyllus*, but the root and caudex commonly more slender; *hairs* of the herbage either all straight and loosely appressed, or some often incurved or contorted; *stems* very short, 0–5 cm. long; *leaves* 1.5–8.5 cm. long,

with 11–17 (19) obovate-cuneate or oval-oblong and obtuse, less often elliptic-oblong and acute leaflets 2–10 mm. long; *calyx* 10.2–14 (14.7) mm. long, the tube 8.4–10.9 mm. long, 2.7–3.9 mm. in diameter, the teeth 1.6–3.3 mm. long; *wings* 17–19.5 (20.7) mm. long, the claws 10.2–12.2 (12.9) mm., the blades 7.4–9 (10.2) mm. long, 2–2.8 mm. wide; *keel* 15.9–18.5 mm. long, the claws 10.3–12.4 mm., the blades 5.7–7 mm. long, (2.2) 2.6–3.4 mm. wide; *pod* (1.7) 2–3.2 (3.7) cm. long, 8–12 (13) mm. in diameter, either strigulose with appressed and subappressed hairs up to 0.6–0.95 mm. long, or villous with loosely spreading, sometimes contorted hairs up to 1–1.65 mm. long.—Collections: 29 (vii); representative: *Payson & Payson 4813* (NY, MO, POM, WS); *Ripley & Barneby 4771* (CAS, RSA); *Christ & Christ 18,569, 18,621* (RSA); *C. L. Porter 3660* (RM).

Dry gravelly or sandy hillsides, stony ridges, mesas, and canyon benches, with sagebrush, juniper, piñon, or mountain-mahogany, sometimes at the edge of oak thickets, mostly on sedimentary bedrock, 6100–8000 feet, rather frequent and locally plentiful in the mountains enclosing the Colorado Basin, from the Grand River north through northwestern Colorado, west along the Uintah Range and south along the east slope of the Wasatch to central Utah; also northwest along the Bear River and adjacent hill country into southwestern Wyoming and southeastern Idaho; apparently disjunctly on the Kaibab Plateau in northwestern Arizona.—Map No. 79.—Late April to July.

ASTRAGALUS ARGOPHYLLUS var. *MARTINI* (Rev. George W. Martin, a botanical correspondent of M. E. Jones) Jones, Rev. Astrag. 208, Pl. 46. 1923.—“Soda Springs, Idaho, June 19, 1901, Rev. Geo. W. Martin.”—Holotypus, POM!

(?) *Astragalus argophyllus* var. *cnicensis* (from *Cnicus*, a genus of thistles, from the type-locality) Jones, Rev. Astrag. 208, Pl. 46. 1923.—“Thistle Utah 1901 . . .”—Holotypus, POM!

Astragalus Purshii × *argophyllus* Jones, Rev. Astrag. 207, Pl. 47. 1923.—“... 5412d Jones from Salina Canon Utah, 6054h Jones from Nagle's Ranch on the Kaibab Arizona . . .” Cotypi, POM! isotypus (No. 5412d), NY!

Astragalus argophyllus var. *pephragmenoides* (resembling *A. pephragmenus*) Barneby in Amer. Midl. Nat. 37: 460. 1947.—“... north slope of Grand Mesa, Mesa Co., Colorado, Ripley & Barneby No. 5437.”—Holotypus, CAS! isotypi, NY, RSA!

Martin's silver-leaved milk-vetch is substantially equivalent to the var. *pephragmenoides* as defined in the preliminary revision of the *Argophylli* (Barneby, 1947); the change of name has become necessary after re-evaluation of the typus of var. *Martini* in the light of recent collections from the Bear River Range and adjacent valleys. The plant on which var. *Martini* was based is in the fruiting stage, and has rather small, appressed-pubescent pods. It might pass for a small individual of either the mesophytic var. *argophyllus* or its xerophytic counterpart, and the habitat was not recorded. However, there is now closely similar material from Bannock and Bear Lake Counties, Idaho, and these plants are known to inhabit dry ground and to have comparatively small and pale flowers.

The typus of var. *pephragmenoides* and the plants from which Jones described a supposed hybrid between *A. argophyllus* and *A. Purshii* (see also under *A. marianus*) differ strikingly from genuine var. *argophyllus* in their loosely villous pods, but the importance of this feature was overemphasized in my revision. I learned subsequently that the form of var. *Martini* with appressed-pubescent fruits, formerly interpreted as intergradient with var. *argophyllus*, is much commoner than was supposed; and it is the villous state which must be regarded as the unusual one, occurring sporadically in the other's range. It is now also clear that there is no really sharp line of separation in flower-size between the mesophytic and xerophytic varieties of *A. argophyllus*. The fact remains, however, that throughout northcentral Nevada north into southwestern Montana var. *argophyllus* is found exclusively in moist ground, whereas var. *Martini* is an obligate xerophyte, never straying from well-drained slopes into the available bottomlands. The ranges of the two forms overlap in southeastern Idaho and in adjoining Wyoming and Utah, but even when closely sympatric are ecologically isolated (cf. Ripley & Barneby 7819, 7827, from Summit County, Utah, gathered within a few yards of one another). Too few collectors have left records of the environment in which their plants were found, and the identity of some collections is truly ambiguous. In the critical area of range-overlap the behavior of var. *argophyllus* and var. *Martini* deserves careful field study.

The identity of var. *cnicensis*, described from plants bearing ripe fruits, is quite doubtful. The pod suggests var. *panguicensis* in shape, but lacks the dense, silky vesture. Search at the type-locality for flowering material, requisite for a sound interpretation of the proposal, has so far been unsuccessful.

192c. *ASTRAGALUS ARGOPHYLLUS* var. *PANGUICENSIS*

Closely resembling the dwarfer states of var. *Martini*, commonly subacaulescent, the stems rarely developed and up to 5 (10) cm. long; *hairs* of the herbage narrowly to widely ascending or subappressed, up to 0.65–1.5 mm. long, silvery-silky; *leaves* 1.5–6 (8) cm. long, with 7–15 (17) oval-obovate, obtuse or very shortly acuminate and then subacute leaflets 2–9 mm. long; *calyx* 9–12 (14) mm. long, the tube 6.8–8.7 (10.6) mm. long, 2.8–3.4 mm. in diameter, the teeth 1.9–3.4 (4.2) mm. long; *banner* 5.6–8.6 (10) mm. wide; *wings* 14.2–17.1 (22.6) mm. long, the claws 8.4–9.4 (12.8) mm., the blades 6.8–8.7 (10.3) mm. long, 2–2.6 mm. wide; *keel-claws* 7.5–9.8 (12.7) mm. long, the blades 4.6–6.1 (8.3) mm. long, 2.5–3.4 mm. wide; *pod* lunately lance-ellipsoid or narrowly and very obliquely ovoid-acuminate, 1.5–2.7 cm. long, 5–8 (9) mm. in diameter, the surface of the valves concealed or nearly so by a dense coat of appressed and narrowly ascending, silvery hairs up to 0.5–0.75 mm. long—Collections: 17 (v); representative: *Maguire* 19,184 (WTU); *Ripley & Barneby* 4882 (CAS, RSA), 8566 (RSA, UTC), 8556, 8574 (RSA).

Gravelly hillsides and benches in yellow pine forest, coming out into sagebrush flats, 6750–9300 feet, locally plentiful about the headwaters of the Sevier River in Garfield, Iron, and Kane Counties, east in Garfield County to the Henry Mountains, Utah; apparently also (with larger flowers) on the slopes of Mt. Emma, Uinkaret Plateau, Coconino County, Arizona.—Map No. 79.—May to July, exceptionally later.

ASTRAGALUS ARGOPHYLLUS var. *PANGUICENSIS* (Jones) Jones, Contrib. West. Bot. 8: 5. 1898 ("Panguicensis"), based on *A. Chamaeleuce* var. *panguicensis* (of Panguitch Lake) Jones in Proc. Calif. Acad. Sci. II, 5: 671. 1895 ("Panguicensis").—"No. 6002m and 6023f, September 8, 1894, Panguitch Lake, Utah, 8400' alt..."—The specimen first cited not found at POM; lectotypus, Jones 6023f, POM!—*A. panguicensis* (Jones) Jones, Contrib. West. Bot. 10: 62, Pl. 4. 1902.

Batidophaca sabinarum (of junipers, or "cedars," from the type-locality) Rydb. in N. Amer. Fl. 24: 320. 1929.—"Type collected in Cedar Canyon, Iron County, Utah, July 19, 1920, A. O. Garrett R2660..."—Holotypus, NY!—*Astragalus sabinarum* (Rydb.) Barneby in Proc. Calif. Acad. Sci. IV, 25: 150. 1944.

Until a few years ago the Panguitch milk-vetch had been collected seldom, consequently the nature and closeness of its relationship to *A. argophyllus* were difficult to estimate. In the summer of 1947 I found it to be quite frequent in the foothills of the Escalante Range in Garfield County, where it was possible to record a variation in flower-size extending up to and slightly overtaking that known in *A. argophyllus* var. *Martini* in the mountains shortly to the north. On the average, the pod of var. *panguicensis* is narrower and more strongly incurved than that of other forms of its species, and its ventral suture is usually more strongly depressed due to the curvature. It is variable in form, however, as are the fruits of all *Argophylli*, and except for its almost always denser and persistent silky vesture provides no infallible criterion. The variety is presumably a recent derivative of var. *Martini*, which has accumulated small differences in pubescence, in size of flower, and in shape of the fruit over a peripheral segment of the species-range.

Long thought to be endemic to the headwaters of the Sevier River, var. *panguicensis* has been collected recently on Uinkaret Plateau north of Grand Canyon in Arizona. One gathering from this outlying station is to all appearances exactly typical (*Cottam* 14,049, CAS). Another (*Cottam* 13,690, CAS) from the same place has exceptionally large flowers suggestive of var. *Martini*, which has been collected not far distant on the Kaibab Plateau. Whether two distinct entities really exist in northern Arizona cannot be told from the material now at hand.

Care must be taken to distinguish the Panguitch milk-vetch from *A. castaneiformis*, a closely similar species of which one variety, var. *consobrinus*, is sympatric with var. *pang-*

guicensis in southcentral Utah. The dolabriform hair-attachment of *A. castaneiformis* is an everpresent clue to its identity at all stages of growth.

193. ASTRAGALUS ZIONIS

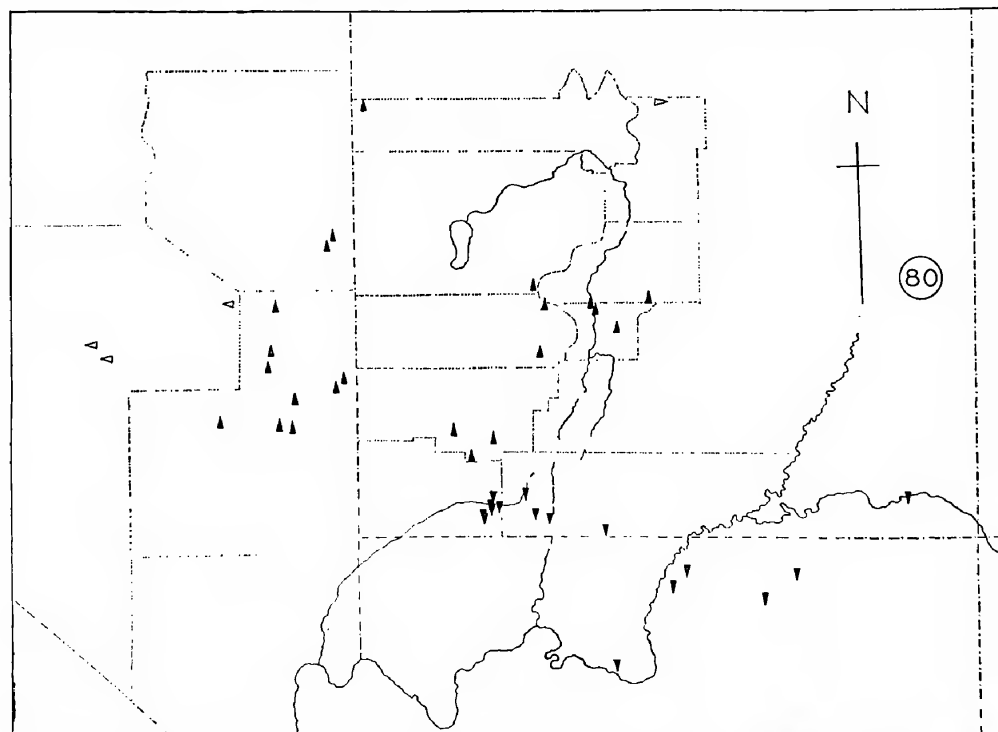
Shortly caulescent or subcaulescent, loosely or densely tufted, with a long taproot and at length repeatedly forking, suffruticulose caudex beset with the scaly remains of stipules and sometimes also with a thatch of stiff, persistent petioles (the whole sometimes buried in drifting sand), densely villous-villosulous, or exceptionally strigulose, with straight or somewhat sinuous, loosely ascending or rarely subappressed, stiff, lustrous hairs up to 0.6–1.1 (1.3) mm. long, the stems commonly villous-tomentulose, the herbage silvery or less often greenish, the inflorescence black-villous; *stems* several or numerous, (0.5) 1.5–7 cm. long, when developed diffuse or prostrate, simple or few-branched near the base, the internodes either concealed by stipules or some of them commonly up to 1 (1.7) cm. long, mostly shorter; *stipules* submembranous, pallid or purplish, several-nerved, becoming papery-scarious and ultimately brownish and glabrate, (1.5) 2–5.5 mm. long, mostly broadly ovate, broader than the stem and often broader than long, the uppermost sometimes lanceolate, all or all but the uppermost amplexicaul-decurrent and shortly connate; *leaves* (2) 3–12 (25) cm. long, with slender, wiry petiole and (11) 13–21 (25) ovate, elliptic, or rhombic-elliptic and acute, rarely obovate and obtuse, flat or loosely folded leaflets 2–12 (16) mm. long, either remote or crowded on the rachis, usually diminishing in size upward; *peduncles* mostly stout, (1) 3–12 (15) cm. long, shorter or exceptionally longer than the leaves; *racemes* shortly but loosely (1) 3–11 (20)-flowered, the axis little elongating, 0.5–4.5 (9) cm. long in fruit; *bracts* membranous, ovate-acuminate or lanceolate, (2) 2.5–5 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1–2 mm., in fruit thickened, 1.3–3 mm. long; *bracteoles* commonly 2, sometimes rudimentary or 0; *calyx* (8.3) 10–13 (18) mm. long, villous-villosulous with all or predominantly black, more rarely with largely white hairs, the oblique disc 1.2–2 mm. deep, the membranous, purplish, deeply campanulate or cylindric tube (6.5) 7–10 (12.7) mm. long, 3.6–4.7 mm. in diameter, the subulate teeth (1.5) 2.2–3.7 (5.7) mm. long, the dorsal one often shortest, the ventral sinus cut back, the orifice oblique; *petals* purple, the claws pale; *banner* broadly oblanceolate or spatulate, 18.5–22.5 (26) mm. long, the rhombic-oval, shallowly notched blade 9.2–12.5 mm. wide; *wings* 17–20.5 (?) long, the claws 8.5–12.2 mm., the narrowly lance-oblong, obtuse blades 9.4–11.2 mm. long, 2.4–3 mm. wide, slightly incurved above the middle; *keel* 14.6–18.6 (19) mm. long, the claws 8.5–12.4 mm., the lunately elliptic blades 6.4–7.8 mm. long, 2.6–3.3 mm. wide, rather gently incurved through 85–95° to the blunt apex; *anthers* 0.65–0.85 mm. long; *pod* ascending (humistrate), obliquely ovoid-, oblong-, or lance-ellipsoid, (1.5) 2–2.7 (3) cm. long, (5.5) 6–9 mm. in diameter, rounded or broadly cuneate at base, gently incurved through up to ½-circle but mostly less into a triangular- or lance-acuminate, laterally compressed beak, dorsiventrally compressed (except sometimes at very base) through the proximal ¾, openly sulcate ventrally at and below the middle and dorsally either at and above the middle or its whole length, bicarinate by the prominent but ± depressed sutures, the fleshy, loosely strigulose or villosulous valves brightly purple- or red-mottled on a green, at length stramineous ground, becoming leathery or subligneous, ± 0.2–0.4 mm. thick and cross-reticulate, either not inflexed, or inflexed in the lower half to form a rudimentary septum less than 1 mm. wide, the walls of the septum sometimes separated, leaving a filiform-tubular chamber behind the dorsal suture; *dehiscence* apical and part-way downward through the ventral suture; *ovules* 24–30; *seeds* brown or yellowish-buff, smooth or sparsely

pitted, 2–3 mm. long.—Collections: 18 (vii); representative: *Eastwood & Howell* 9229 (CAS, GH, RSA, WS); *Jones* 5239 (NY, POM, UC); *Eastwood* 5993 (CAS); *Ripley & Barneby* 4366, 4854, 5371 (RSA), 4868 (CAS, GH, RSA); *J. T. Howell* 24,428 (CAS, RSA).

Rock ledges, sandy talus in canyons and at the foot of cliffs, sometimes washed down and temporarily persisting on the valley floor, in sandy soils derived from red and white sandstone, 4000–7100 feet, locally abundant along the Zion Escarpment in Washington and Kane Counties, Utah, and in scattered stations along the Colorado and San Juan Rivers and their tributary creeks from Grand Canyon, Coconino County, Arizona, northeast across northern Arizona into southern San Juan County, Utah.—Map No. 80.—Late April to June.

ASTRAGALUS ZIONIS (of Zion Park) Jones in Proc. Calif. Acad. Sci. II, 5: 652. 1895 ("Zionis").—"No. 5261w. May 17, 1894, Springdale, Utah, 4000° alt., in red sand..."—Jones also cited his numbers 5249h, 5224d, 5001b, 5249g, all collected the same year and in the same immediate region.—Holotypus, *Jones* 5261w, POM! isotypus, US!—*Xylophacos zionis* (Jones) Rydb., Fl. Rocky Mts. 504. 1917.

The Zion milk-vetch is a variable species, consisting of many isolated populations scattered through the deeply dissected sandstone country of the Colorado Plateau. The vesture of the whole plant is commonly villous, but in some small areas, as along Clear Creek in Zion Park, the leaves are strigose with appressed or subappressed hairs. The plants from the canyons of the San Juan and Colorado Rivers are generally, perhaps always larger-flowered than those from the Zion Escarpment, but this point needs verification from more abundant flowering material. Despite its connate stipules, anomalous in sect. *Argophylli*, the Zion milk-vetch is closely related to *A. argophyllus*, and even though the species has marked individuality of aspect (and is seldom misidentified), technical differential characters are hard to find. It is maintained as a species distinct from *A. argophyllus* because the connate stipules and brightly



Map No. 80. Southern Utah and parts of Arizona and Nevada. Range of *A. zionis*; of *A. marianus*; of *A. desereticus*; and of *A. callithrix*.

mottled pod are linked with characteristic ecological and distributional patterns. On Zion Escarpment *A. zionis* occupies the same ecological niche as the taxonomically isolated *A. striatiflorus*; the two species have twice been found in immediate association on the hummocked dunes close under the summit cliffs. These two astragali are similarly organized up to the flower and fruit, and it may be significant that *A. zionis* differs from *A. argophyllus* var. *Martini* precisely in certain characters which are highly developed in *A. striatiflorus*, notably in the united stipules and an incipient septum. It is perhaps too fanciful to assume that introgression between *A. striatiflorus* and *A. argophyllus* var. *Martini* (however conveniently near at hand on the plateau above the escarpment) has given rise to the Zion milk-vetch, for the features common to *A. zionis* and *A. striatiflorus* may have been acquired by convergent evolution acting within a narrow set of physiological pressures. In any case *A. zionis* is certainly a self-perpetuating species which now occupies a range much more extensive than *A. striatiflorus* and ecologically separated from that of *A. argophyllus*.

In the preliminary account of sect. *Argophylli* (Barneby, 1947) the then imperfectly known *A. arietinus* var. *stipularis* was listed as a synonym of *A. zionis*, thereby seeming to extend the range of the species into Colorado. The var. *stipularis* is now known to belong with *A. naturitensis* Pays. and the Zion milk-vetch reaches its known eastern limit at Bluff on the San Juan River.

194. ASTRAGALUS MARIANUS

Acaulescent or very shortly caulescent, with a taproot and ultimately forking, slender but sometimes suffruticulose caudex, densely strigulose-strigose with relatively coarse, lustrous, mostly straight, appressed and often some narrowly ascending hairs up to 0.75–1.5 mm. long, the herbage silvery; *stems* 0–5 cm. long, when developed the internodes all very short, mostly concealed by stipules, none over 6 mm. long; *stipules* papery-membranous or early becoming so, ovate, ovate-acuminate, or broadly lanceolate, 2–7 mm. long, decurrent-amplexicaul around $\frac{1}{2}$ to the whole stem's circumference, free, often broader than the stem; *leaves* (2) 3–8.5 cm. long, with slender, deciduous petiole and (7) 9–17 mostly obovate-cuneate to broadly oblanceolate and obtuse, less often truncate-emarginate or shortly acuminate, rarely rhombic-elliptic or -obovate and acute, flat or loosely folded leaflets 3–11 mm. long; *peduncles* (1) 1.5–6 (8) cm. long, slender and ascending at anthesis, stouter and either arcuate-recurved or straight and humistrate in fruit; *racemes* shortly but loosely (2) 3–10 flowered, the axis little elongating, 0.5–2 (2.5) cm. long in fruit; *bracts* membranous, pallid or purplish, ovate or ovate-acuminate, 2–4.5 mm. long; *pedicels* at anthesis slender, straight, ascending, 0.8–2 mm., in fruit thickened, often arched outward, 2–3 mm. long; *bracteoles* usually 0, rarely 1–2; *calyx* 10–12 mm. long, strigose-pilosulous with black or mixed black and white, appressed or ascending hairs, the disc 1.3–1.7 mm. deep, the membranous, often purplish, cylindric tube 7.3–9.4 mm. long, 2.9–3.9 (4.3) mm. in diameter, the broadly to narrowly subulate teeth 2–3 (3.5) mm. long; *petals* pink-purple, often pallid proximally, the banner commonly broadly purple-margined and the wings and keel purple-tipped; *banner* recurved through 40°, broadly oblanceolate or rhombic-oblanceolate, notched or subentire, 17–21 (24) mm. long, 7.6–9.5 mm. wide; *wings* 16.2–19.6 (21) mm. long, the claws 9.2–11.7 mm., the narrowly oblong or lance-oblong, obtuse, nearly straight blades 7.7–10.5 mm. long, 2–2.6 (3) mm. wide; *keel* 15.3–19 (20) mm. long, the claws 9.4–12 mm., the lunately elliptic blades 6.2–8.7 mm. long, (2.2) 2.5–3.3 mm. wide, gently incurved through 45–85° to the blunt apex; *anthers* 0.6–0.75 mm. long; *pod* spreading-ascending (humistrate), readily dis-jointing from the low-conic or slightly produced receptacle (the gynophore up to 1 mm. long), obliquely ovoid-acuminate, 1–2.3 cm. long, 7–12 mm. in diameter, obtuse at base, obcompressed and nearly straight in the lower $\frac{1}{2}$ – $\frac{2}{3}$, thence gently or abruptly incurved and contracted into the laterally compressed, triangular or lance-acuminate, cuspidate beak, shallowly sulcate ventrally, flattened or low-convex dorsally toward the base, the fleshy valves becoming rigidly leathery, retic-

ulate and slightly rugulose on the angles, densely shaggy-hirsute and commonly also tomentulose with shorter entangled and longer spreading, straight and spirally twisted, or $\pm$ sinuous and curly, lustrous hairs up to (1.7) 2–3.5 mm. long, the surface partly or wholly concealed by the vestiture; *dehiscence* apical, after falling, the beak splitting and gaping to release the seeds; *ovules* 27–36; *seeds* black or purplish-black, sparsely pitted, dull or sublustrous, 2.6–3.2 mm. long.—Collections: 21 (vii); representative: *Ripley & Barneby* 3315 (CAS, NA, RSA); *Train* 2534, 2627 (NA); *Ripley & Barneby* 6325 (CAS, RSA), 9244 (RSA; *Jones* 5198 (POM), 5200 (NY, P, POM).

Dry gravelly hillsides among sagebrush, in juniper or piñon forest, and about oak thickets, (4500) 5800–7200 feet, ascending (in the Snake Range, White Pine County) into yellow pine forest between 8200–10,000 feet, most abundant on limestone, rather frequent and locally plentiful in the mountains and foothills enclosing the Sevier Basin to the east, south and west, in Lincoln and White Pine Counties, Nevada, and in Beaver, Iron, Millard, Piute, and Sevier Counties, Utah.—Map No. 80.—April to June (July), occasionally again in fall.

ASTRAGALUS MARIANUS (Rydb.) Barneby in Proc. Calif. Acad. Sci. IV, 25: 150. 1944, based on *Xylophacos marianus* (of Mary, from the type-locality at Marysvale) Rydb. in Bull. Torr. Club 52: 233. 1925.—“Type collected at Marysvale, Utah, June 1, 1894, *Jones* 5355.”—Holotypus, NY! isotypi, MO, POM (2 sheets), US!

Flowering plants of the Sevier milk-vetch, *A. marianus*, simulate silvery states of *A. argophyllus* var. *Martini* so closely that the two species cannot be safely distinguished until the fruit is sufficiently far advanced to show the length and density of its hairy covering. Separated from the plant, the pod of *A. marianus* would pass readily for that of *A. Newberryi* or *A. Purshii*; some examples of the species were taken by Jones for hybrids between *A. argophyllus* and *A. Purshii*, although we now know that its range lies far to the south of that of the second of the supposed parents. It is superfluous to invoke a hypothesis of hybridity to explain the existence of a species found in uniform condition over an extensive continuous territory. Also encountered on several occasions growing intermixed with *A. Newberryi*, or at close quarters with it in identical environment, the Sevier milk-vetch has always been distinguished readily by the slender divisions of its caudex which lack the thatch of persistent petioles so characteristic of *A. Newberryi*, by the more numerous, ordinarily much smaller leaflets, and by the smaller flowers. The Sevier milk-vetch is thought to be derived directly from *A. argophyllus* var. *Martini*, from which it differs principally in its densely hirsute-tomentose pod, a feature which seems to have developed independently in three separate lines of modification in the *Argophylli*. The species is easily separated from the next, *A. desereticus*, by its stiffer, more appressed vestiture, longer keel, and in particular by the larger, many-ovulate pod.

An earlier account of *A. marianus* (Barneby, 1947, p. 484–5) contains several errors through oversight of a genus-cover at POM which contains important clues to the identity of Jones's supposed hybrids involving *A. Purshii*, *A. Newberryi*, and *A. argophyllus*. In the first place there came to light two fine isotypic sheets of *A. marianus* which Jones had annotated as *A. argophyllus* $\times$ *Purshii*, not *A. Purshii* $\times$ *Newberryi*. The specimens agree well enough with Jones's description of the supposed *Purshii* $\times$ *argophyllus* cross, but the typus of this proposal must be chosen from among specimens actually cited by Jones, and in consequence it has been removed to the synonymy of *A. argophyllus* var. *Martini*. Jones's ideas about this entire group of species were evidently in a state of flux, for he annotated, as representing the imaginary hybrid, specimens both of *A. argophyllus* var. *Martini* (No. 5601c, from Soldier Summit) and of *A. marianus* (No. 5200, from Cedar City). On the other hand, the hybrid formula *A. Purshii* $\times$ *Newberryi* was based primarily on typical material of the second parent.

195. *ASTRAGALUS DESERETICUS*

Loosely tufted, shortly caulescent, with a suffrutescent caudex and annual stems up to 2–5 cm. long, densely villosulous and hirsute with fine, contorted, together with longer, straightish, ascending hairs up to 1 mm. long, the herbage silvery, the leaflets equally pubescent on both sides; *stipules* submembranous becoming papery, broadly deltoid-acuminate to lanceolate, 3.5–7 mm. long, semiamplexicaul; *leaves* 4–11 cm. long, with slender petioles and (7) 11–17 elliptic

to broadly obovate and abruptly short-acuminate, flat leaflets 2–10 mm. long; *peduncles* 2–5.5 cm. long, decumbent and humistrate in fruit; *racemes* loosely but very shortly 5–10-flowered, the flowers ascending, the axis little elongating, 0.5–2 cm. long in fruit; *bracts* lance-acuminate or -caudate, 3–6 mm. long; *pedicels* ascending, at anthesis $\pm$ 2 mm., in fruit little thickened, 2–3 mm. long, disjointing in age; *bracteoles* 0–2; *calyx* 8.4–11.5 mm. long, thinly white-villous-hirsutulous, the scarcely oblique disc 1–1.3 mm. deep, the cylindric or deeply campanulate tube 6.2–7.5 mm. long, 3–3.7 mm. in diameter, the subulate teeth 2–4 mm. long; *petals* apparently whitish except for the faintly maculate keel-tip; *banner* recurved through $\pm$ 40°, rhombic-oblongate, deeply notched, 18–22.5 mm. long, 6.8–9.5 mm. wide; *wings* 16–18.6 mm. long, the claws 7.5–7.8 mm., the narrowly lanceolate, obtuse, nearly straight blades 9.6–12 mm. long, 2.2–2.5 mm. wide; *keel* 12–13.3 mm. long, the claws 7.4–7.8 mm., the half-obovate blades 5.2–6.2 mm. long, 2.4–3 mm. wide, gently incurved through 80° to the rounded apex; *anthers* 0.6–0.7 mm. long; *pod* ascending (humistrate), sessile on a glabrous, stipelike gynophore up to 0.9 mm. long, similar to that of *A. Purshii* or *A. marianus* but very small, 1–1.2 cm. long, 4–5 mm. in diameter, strongly incurved near the middle, densely hirsute with lustrous hairs up to 2–2.5 mm. long; *dehiscence* and *seeds* not seen; *ovules* 14–16.—Collections: 2 (o); representative: Jones (approximate topotypus, June 2, 1893), DS, US.

Habitat not recorded, but to be sought on dry hillsides among sagebrush at about 6000–6500 feet, known only from near Indianola, in northern San Pete (or perhaps adjoining Utah) County, central Utah.—Map No. 80.—May and June.

ASTRAGALUS DESERETICUS (of Deseret, the Mormon name for Utah), sp. nov., hinc *A. mariano* illinc *A. argophyllo* var. *Martini* affinis, ab illo pube laxiori hirsuto-villosula, ab ambobus tubo calycino breviori, petalis inter se magis inaequalibus (vexillo 18–22.5 mm. sed carina 12–13.3 mm. tantum longis), et praesertim legumine parvulo ovula pauca (14–16 nec 25–43) gignentis absimilis. Ab *A. argophylli* formis omnibus legumine more *A. mariani* vel *A. Purshii* dense hirsuto ulterius differt. Species imperfecte cognita ulterius observanda jam a cl. Jones prolem hybridam esse in herbario designata et characteribus nonnullis inter subsect. *Argophyllos* et *Eriocarpos* quasi intermedia, sed parentes necessarii regioni carent et legumen pauciovulatum parvum *A. deseretico* solo inter *Argophyllos* utahenses proprium.—UTAH: common on slopes near Indianola, June 17, 1909, Ivar Tidestrom 2249.—Holotypus, GH!

The typus of *A. desereticus* was mentioned in my revision of sect. *Argophylli* as representing a small-flowered form or possibly distinct variety of *A. marianus* (1947, p. 485). Search for more ample material in the type-region has been unsuccessful, but I have since seen a specimen (Jones, cited above) from "below Indianola" which must be associated with Tidestrom's plant. These two collections share some important diagnostic features and seem to establish the existence of an entity discrete from all *Argophylli* described hitherto. The general appearance of Jones's plant is suggestive of *A. Purshii* var. *concinus*, for the leaflets are broadly obovate and only 11–15 in number; but the coarse character of the pubescence is at variance with all forms of *A. Purshii* or its close relatives in subsect. *Eriocarpi*. The leaflets of Tidestrom's plant are of a narrower, elliptic type and slightly more numerous in developed leaves, so that the superficial facies recalls *A. argophyllus*. On account of the loose vesture both collections might be mistaken for *A. argophyllus* var. *Martini*, but there is no other example of the latter with a pod so densely long-hirsute. The pod alone is essentially like that of *A. Purshii* or of *A. marianus* on a reduced scale, but only some distantly allopatric varieties of the former have fruits as small or ovules so few, and these are softly cottony-tomentose throughout. From other *Argophylli* with densely hirsute-tomentose pods, *A. desereticus* differs further in its more strongly graduated petals; and although the flowers are of nearly the same length as in *A. marianus*, the keel is much shorter. Jones distributed his collection as a hybrid of unknown parentage, but even though the vesture is somewhat intermediate in character between the extremely fine cottony type of the *Eriocarpi* and the stiffer, usually lustrous type of the genuine *Argophylli*, thereby suggesting an *A. argophyllus* $\times$ *Purshii* or *argophyllus* $\times$ *utahensis* cross, no known parents occur in central Utah which could have provided the genes for a small flower, small pod, and few seeds. Probably *A. desereticus* is another species of local distribu-

tion similar to *A. callithrix* or *A. uncialis* of the same section. It will be interesting to learn whether this apparent rarity is due to a recent origin, presumably by mutation from *A. argophyllus*, or to some set of environmental factors.

196. ASTRAGALUS CALLITHRIX

Shortly caulescent or subcaulescent, loosely tufted, perennial but of short duration and flowering the first season, the stems and herbage densely white-pilose with straight and narrowly ascending, together with somewhat curly and subappressed hairs up to 1–1.5 mm. long; *stems* few or sometimes solitary, prostrate or ascending from the root-crown or from a shortly forking caudex, 1–6 (exceptionally, in shelter of sagebrush, up to 15) cm. long, branched or spurred at or below the middle, the internodes either developed and up to 1 (3.5) cm. long, or all contracted and concealed by stipules; *stipules* submembranous, ovate or triangular-acuminate, 2–5 mm. long, erect, pilose dorsally, semiamplexicaul; *leaves* 2–8 (14) cm. long, with flaccid, deciduous petiole and (7) 9–19 (21) obovate, obovate-cuneate, suborbicular, or rarely broadly lanceolate, obtuse or truncate-emarginate, flat or loosely folded, thick-textured leaflets 2–13 mm. long; *peduncles* (1) 2–5 (13) cm. long, shorter than the leaf, at first anthesis erect or arcuate-ascending, spreading or procumbent in fruit; *racemes* loosely but sometimes subcapitately 5–15-flowered, the axis scarcely elongating, 0.5–4 (8) cm. long in fruit; *bracts* membranous with firm midrib, lanceolate or lance-acuminate, 3–7.5 mm. long; *pedicels* at anthesis slender, 1–1.5 mm. long, in fruit thickened but scarcely or not elongating, ascending or arched outward; *bracteoles* 0–2, minute when present; *calyx* 6.8–13.3 mm. long, the obliquely turbinate disc 0.9–1.8 mm. deep, the membranous, purplish, cylindric tube 5.5–10.8 mm. long, 2.7–4 mm. in diameter, the subulate or lanceolate teeth 1–3.2 mm. long, the dorsal one sometimes shortest, the ventral sinus deeply cut back, the orifice oblique; *petals* bright pink-purple; *banner* recurved through $\pm 40^\circ$, oblanceolate or rhombic-oblanceolate, emarginate, 16–26 mm. long, 6–11 mm. wide; *wings* 15.3–23.8 mm. long, the claws 6–11 mm., the linear-oblong or -lanceolate, obtuse, nearly straight blades 10–14.5 mm. long, 2–2.8 mm. wide; *keel* (12) 13–20.7 mm. long, the claws 6.8–11.5 mm., the lunately half-elliptic blades 7–10 mm. long, 2.8–3.4 mm. wide, gently incurved through $\pm 45^\circ$ to the broadly rounded apex; *anthers* 0.5–0.7 mm. long; *pod* ascending or loosely spreading (commonly humistrate), obliquely oblong-ovoid, 1–1.6 (2) cm. long, 5–7.5 mm. in diameter, slightly tumid, truncate or rounded at base, in the lower $\frac{1}{3}$ straight, strongly obcompressed, and dorsally flattened or openly sulcate, passing upward and incurved through $90\text{--}180^\circ$ into a deltoid or triangular-acuminate, sharply cuspidate, laterally compressed beak, the somewhat fleshy, green valves hirsute (but not so densely as to conceal either the shape or surface of the pod) with fine, lustrous, widely spreading, straight or somewhat twisted hairs up to 2–2.5 mm. long, becoming stramineous, smooth or a trifle rugulose, not inflexed; *dehiscence* apical, through the gaping beak, after falling; *ovules* 24–34 (37); *seeds* ocher-brown, smooth or nearly so, ± 2 mm. long.—Collections: 4 (ii); representative: *Magurie & Holmgren* 25,139 (CAS, MO, NY, RSA, TEX, WS); *Ripley & Barneby* 4434 (CAS, GH, RSA); *Raven* 13,533 (NY).

Bare open places on semistabilized dunes or in deep sandy soil on the floor of sagebrush valleys, 5100–5200 feet, locally plentiful but apparently rare and highly localized, known only from a small area lying between the Quinn Canyon and Hot Creek Ranges in northeastern Nye County, Nevada.—Map No. 80.—May and June.

ASTRAGALUS CALLITHRIX (with beautiful hair) Barneby in Leaf. West. Bot. 3: 103, Pl. opp. p. 108, fig. C. 1942.—“NEVADA: . . . seven miles south of Callaway, northeast Nye Co.,

altitude 5150 ft., 26 May 1941, . . . Ripley & Barneby No. 3531."—Holotypus, CAS! isotypus, RSA!

This decorative, dwarf, large-flowered astragalus is related to *A. marianus* and probably represents a recently specialized derivative which has become adapted to a dune habitat. As shown on the map of dispersal, the ranges of *A. marianus* and *A. callithrix* are contiguous but not overlapping, and their ecological requirements are so different that they could not become closely sympatric. To the differential characters already brought out in the subsectional key, I should add that the racemes of *A. callithrix* are on the average more numerous flowered and tend to become both longer and looser in fruit, while the petals (so far as observed when fresh) are much more richly colored. In the original publication *A. callithrix* was compared with *A. utahensis* and *A. nudisiliquus*. The latter is similar in so far that the pod is only thinly hirsute and not at the same time tomentose, but *A. callithrix* lacks the fine cottony pubescence which is characteristic of subsect. *Eriocarpi*, and I can no longer see any suggestion of close kinship in that direction.

The Callaway milk-vetch, *A. callithrix*, is known at present from only two valleys in northeastern Nye County, these parallel but separated by the low volcanic Pancake Range. In the more western valley, where the species is abundant over a considerable area to the north and northeast of Warm Springs, the flowers are much larger than found in the type-station (calyx ± 10 –13, not ± 7 mm., banner 22.5–26, not ± 17 mm. long) and the ovules are more numerous (29–37, not 24–26). Evidently two populations exist, effectively restricted to their islands of sandy soil within an oceanic waste of undifferentiated sagebrush. The evaluation of these variants must await a more thorough scrutiny of the region, for other populations with flowers of intermediate size may exist.

197. ASTRAGALUS TEPHRODES

Low but sometimes quite coarse, loosely or densely tufted perennials, acaulescent or shortly caulescent, the caudex ultimately branching but scarcely lignescent, the vesture of the whole plant extremely variable both in density and orientation of the hairs, the herbage strigulose, pilosulous, or villosulous with straight and appressed, straight and largely or partly ascending, incurved and ascending, or sometimes largely or exclusively loose and sinuous hairs up to 0.4–0.9 (1) mm. long, either green, or greenish-cinereous, or silky-canescens, the leaflets either equally pubescent on both sides or medially glabrescent to glabrous above, the upper surface commonly brighter green (even beneath the vesture) than the lower; stems several, 0–15 cm. long, prostrate when developed, the internodes either all concealed by stipules, or a few produced and up to 2 (2.5) cm. long, the whole stem in any case shorter than the longest leaves and inflorescences; stipules submembranous becoming papery-scarious and pallid, deltoid, ovate-acuminate, lance-acuminate, or -caudate, 2–15 mm. long, decurrent around $\frac{1}{2}$ or more of the stem's circumference, very exceptionally a few of the lowest pairs fully amplexicaul and obscurely connate, all thinly to densely pubescent dorsally, rarely subglabrous; leaves 3–24 cm. long, all petioled, with 11–31 broadly oblanceolate, obovate, oval, rhombic-ovate, -elliptic, or rarely suborbicular, obtuse, acute, or rarely emarginate, flat or loosely folded leaflets 2–27 mm. long, the midrib sometimes prominent beneath; peduncles stout or quite slender, 4–40 cm. long, either longer or shorter than the leaf, commonly incurved-ascending but sometimes erect at anthesis, either arcuate-procumbent or prostrate and radiating in fruit; racemes loosely (9) 10–26 (35)-flowered, the axis somewhat or scarcely elongating, 2–20 cm. long in fruit; bracts membranous becoming scarious, lanceolate or ovate-acuminate, 1.5–11 mm. long; pedicels ascending or a trifle arched outward, at anthesis slender, 0.6–2.2 mm., in fruit thickened, 1.2–3.4 mm. long; bracteoles usually 0, if present very rarely conspicuous; calyx (5) 6–14 mm. long, loosely strigulose, pilosulous, or rarely villous, with white or mixed white and black, subappressed, ascending, or loosely spreading, straight or sinuous hairs up to 0.4–0.85 (1.1) mm. long, the oblique disc 1–2.8 mm. deep, the cylindric to deeply campanulate, pallid or often purplish tube (3.5) 4.5–10.2 mm. long,

3.2–5.2 mm. in diameter, the subulate or triangular-subulate teeth 1.2–3.8 mm long, the ventral pair often broadest and sometimes longest, the whole becoming papery, ruptured, marcescent; *petals* pink-purple to dull lilac, sometimes dirty white but the banner then margined and the keel tipped with some shade of dull or lively purple, the anthocyanin turning bluish when first dried, fugacious with time; *banner* gently recurved through $\pm 45^\circ$ (or further in withering), obovate cuneate, broadly oblanceolate, rhombic-elliptic, or spatulate, shallowly notched to subentire, 11.5–24 mm. long, 6.7–12.3 mm. wide; *wings* a trifle shorter to a trifle longer than the banner, (10.8) 11.8–22.7 mm. long, the claws (4) 4.2–13.2 mm., the lance-oblong or narrowly oblong, obtuse, nearly straight blades (7.2) 8.1–12.3 mm. long, 2.3–3.7 mm. wide; *keel* (9.2) 10.2–20.1 mm. long, the claw (4.2) 4.5–13.5 mm., the half-obovate or lunately elliptic blades (5.6) 6.4–8.8 mm. long, (2.5) 2.9–4 mm. wide, gently and evenly or sometimes abruptly incurved through $80\text{--}95^\circ$ to the blunt apex; *anthers* 0.5–0.85 (0.9) mm. long *pod* ascending (humistrate), obliquely lance-ellipsoid, oblong- or ovoid-ellipsoid more rarely ovoid-acuminate, 1.3–4 cm. long, 5–16 mm. in diameter, lunately incurved its whole length or straight proximally and only the beak incurved, rounded or truncate at base, contracted distally into a deltoid, triangular, or lance-acuminate cuspidate, laterally compressed beak 3–10 mm. long, elsewhere strongly obcompressed, flattened or low-convex dorsally, carinate ventrally by the thick, obtuse prominent but often depressed suture, the dorsal suture also salient but narrower than the ventral one and commonly undulate, the thinly to quite thickly fleshy green or purplish, densely to quite thinly strigulose-pilousulous or rarely glabrous valves becoming stramineous or brownish, thinly leathery to stiffly woody, transversely reticulate or rugulose, when fleshy also longitudinally wrinkled, not inflexed, or if so the septum very narrow and obscure, not over 1 mm. wide; *dehiscence* apical, after falling, the beak gaping, the exocarpic sutures splitting lengthwise in age; *ovules* 24–45; *seeds* brown or black, smooth, pitted, or somewhat wrinkled, dull or moderately lustrous, 1.8–3.6 mm. long.

The taxonomic complexity of *A. tephrodes*, sens. lat., was discussed at length in a preliminary revision (Barneby, 1947, pp. 463–471), and it only remains to add that subsequent field experience has done little to clarify the racial situation within the species. Any hope that the pubescence-phases of var. *brachylobus* might be more exactly defined by means of ecological correlation has proved groundless, and the reduction of *A. remulcus*, *A. pephragmenus*, and *Xylophacos lenophyllus* to one polymorphic variety was fully justified. In most given populations of var. *brachylobus* the individual members are rather uniform in vestiture, but some show marked variation. On the north slope of Pinal Mountain in Gila County, Arizona strigulose-cinereous plants closely resembling the typus of var. *brachylobus* have been seen growing promiscuously with silvery-hirsute plants apparently identical with the typus of *A. pephragmenus*, a species which originated on the "crest of the Pinals." Thinly strigulose, finely villousulous, and densely silvery-pilous states of var. *brachylobus* have been collected in identical environments in yellow pine forest, sometimes only a few miles apart. The whole species seems to be genetically unstable in this respect.

As more and more material of *A. tephrodes* has been studied, a picture has been built up of an almost uninterrupted clinal series of slight modifications extending spatially, in approximately linear sequence, across Arizona to extreme southern Utah, southern Nevada, and adjoining California. The smallest flowers and the smallest pods of thinnest texture are found at or near the southeastern limit of the species-range, the longest flowers and largest, most fleshy pods at somewhat isolated points to the northwest. An attempt to organize this series by fragmentation into subsidiary groups is bound to be somewhat arbitrary, and the varieties defined below should be understood as points on a sliding scale or as nominal foci about which like forms can advantageously be brought together for purposes of classification. There can be very little question that the type-populations of var. *tephrodes* and var. *eurylobus*, which differ from each other so greatly and in so many features, are genetically distinct, and the aims of taxonomy would be defeated if they were united under one name. However, as soon as the small-flowered var. *tephrodes* is detached from the body of the species, logic demands equal treatment for the robust extremes which have differentiated out at the opposite end of the

series. For this reason var. *brachylobus* of my earlier revision is here further broken up into three coordinate varieties. The following key does not pretend to account for states intermediate between the foci of variation.

Key to the Varieties of *A. tephrodes*

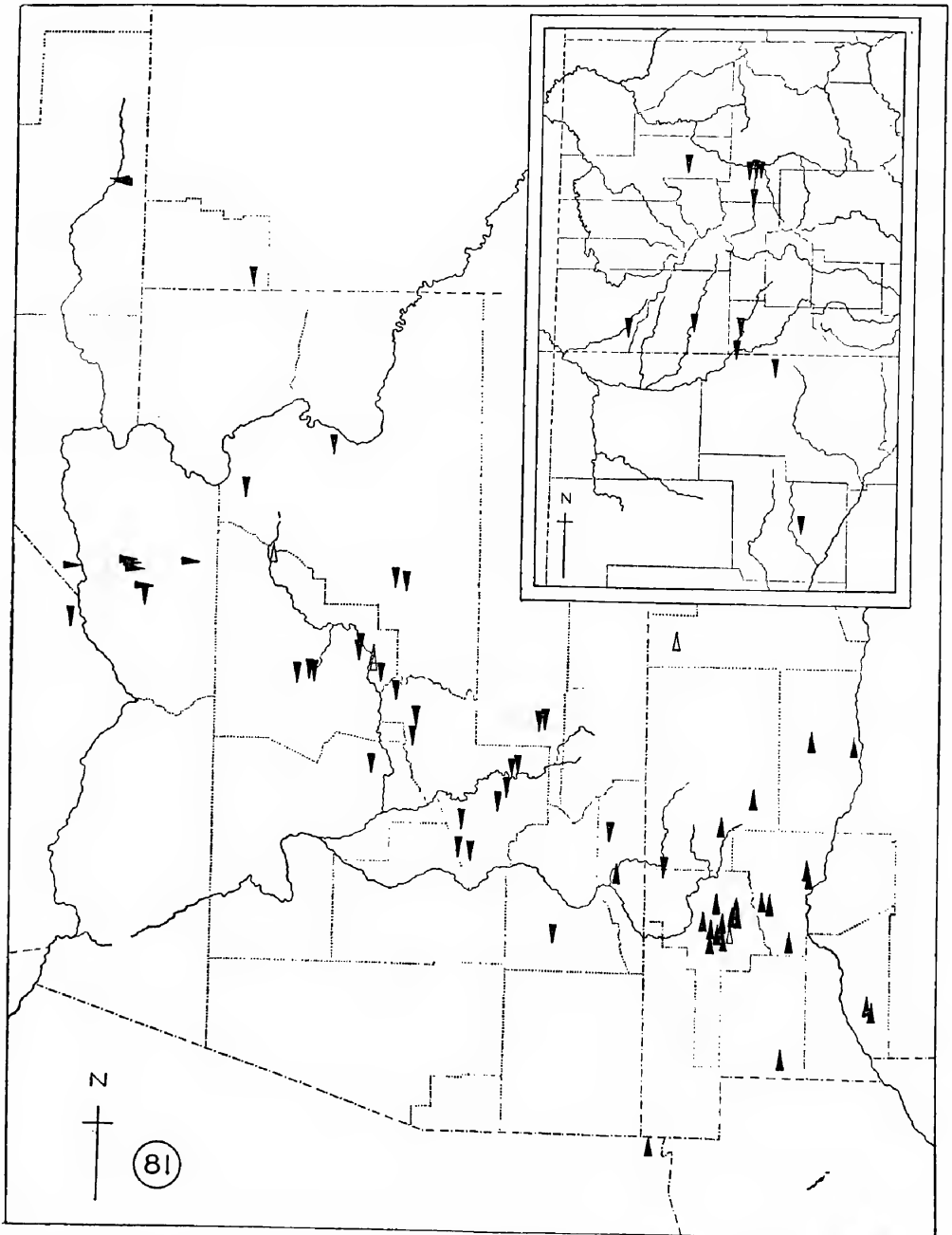
1. Pod 1.3–3.4 cm. long, 5–10 mm. in diameter; *ovules* 24–36; *seeds* 1.8–3 mm. long; widespread from s. New Mexico across Arizona to the Colorado River near Needles, California, and to the Virgin Valley in s.-w. Utah (2)
2. Flower and pod relatively small: *calyx-tube* mostly 4.5–6.8 mm., the teeth 1.2–2.2 mm. long; *banner* 11–17.5 mm., keel (9.2) 10.2–14.6 mm. long; *pod* 1–2 (2.3) cm. long, the walls thinly leathery; *leaflets* mostly conduplicate; s. New Mexico and adjoining Mexico, w. across Arizona approximately to the Verde Valley 197b. var. *tephrodes*
2. Flower and pod larger: *calyx-tube* 7.1–10.2 mm., the teeth 1.7–3.8 mm. long; *banner* (14) 16–24 mm., keel 14.7–20.1 mm. long; *pod* (1.7) 2–3.4 cm. long, 6–10 mm. in diameter, stiffly leathery or woody; *leaflets* mostly flat; Arizona, and extending feebly into s. Nevada, s.-w. Utah, and extreme s.-e. California, passing e.-ward along the upper Gila River into the preceding (3)
3. Peduncles (4) 5–15 cm. long; *racemes* relatively short, the axis (1.5) 2–8 cm. long in fruit; widespread in the range given above, mostly above 4300 ft. elevation 197a. var. *brachylobus*
3. Peduncles very stout and elongate, 1.3–4 dm. long; *racemes* elongate, the fruiting axis 7–20 cm. long; local in n.-w. Arizona and extreme s. Nevada, 3000–4500 ft. elevation 197c. var. *chloridae*
1. Pod 2.5–4 cm. long, 1–1.6 cm. in diameter; *ovules* 34–45; *seeds* 3–3.6 mm. long; Lincoln County, Nevada 197d. var. *eurylobus*

197a. *ASTRAGALUS TEPHRODES* var. *BRACHYLOBUS*

Variable in habit within the limits given below; *herbage* greenish-cinereous to silvery-silky, the hairs varying from straight to incurved or sinuous, and from strictly appressed to loosely ascending or partly spreading, the longest up to 0.4–0.9 mm. long, the leaflets equally pubescent on both sides or nearly glabrous above; *stems* 0–8 cm. long; *stipules* 2.5–11 mm. long, villosulous, sparsely strigulose, or nearly glabrous dorsally; *leaves* 4–16 cm. long, with 11–27 (31) obovate-cuneate, oblanceolate, or rhombic-elliptic, rarely suborbicular, obtuse, acute, or emarginate leaflets (3) 4–17 mm. long; *peduncles* (4) 5–15 cm. long, shorter to much longer than the leaf; *racemes* 10–25 (35)-flowered, the axis (1.5) 2–8 cm. long in fruit; *calyx* 8.8–12.7 mm. long, pilosulous to loosely strigulose, more rarely villos, with mixed black and white hairs up to 0.5–0.85 (1.1) mm. long, the tube 7.1–10 mm. long, 3.4–4.8 mm. in diameter, the teeth 1.7–2.8 mm. long; *banner* (14) 18–24 mm., wings 15.4–22.7 mm., keel 14.7–20.1 mm. long; *pod* oblong-ellipsoid to lance-ellipsoid, more rarely ovoid-acuminate, 1.7–3 cm. long, 6–10 mm. in diameter, the stiffly leathery or subligneous valves strigulose, pilosulous, or exceptionally glabrous; *ovules* 24–35.—Collections: 25 (viii); representative: Ripley & Barneby 5236 (CAS, NY, RSA); A. & R. Nelson 1959 (GH, NY); Barneby 12,626, 12,652 (CAS, RSA); Peebles 11,612 (CAS, POM).

Open hillsides and stony flats in oak-chaparral, in juniper or yellow pine forest, or in arid grassland, on volcanic, granitic, or rarely sedimentary bedrock, mostly between 4300 and 6450 feet, but descending westward down to 3400 feet (and possibly lower along the Colorado River), common and locally abundant along the crest of the Mogollon Escarpment and through the hill-country immediately to the south, extending thence less commonly north to the south slope of the Kaibab Plateau (and to an isolated station in the Virgin Valley in Washington County, Utah), west to the Colorado River at Needles, California, and southeast around the edge of the Gila Basin to extreme westcentral New Mexico, there passing insensibly into var. *tephrodes*.—Map No. 81.—April to June, rarely later.

ASTRAGALUS *TEPHRODES* var. *BRACHYLOBUS* (Gray) Barneby in Amer. Midl. Nat. 37: 466. 1947, based on *A. Shortianus* var. *brachylobus* (with short pod, by comparison with that of *A. Shortianus*, inapposite in the present context) Gray in Proc. Amer. Acad. 13: 367. 1878.—“Arizona.”—Lectotypi (Barneby, op. cit. 467, 469), *E. Palmer 115*, in 1876, from Cottonwood, Arizona, and 102, from Prescott, Arizona, GH! isotypi, K (No. 102), NY! *A. amphioxys* var. *brachylobus* “Gray” ex Jones, Rev. Astrag., Index, in syn., nom. nud. *Xylophacos brachylobus*



Map No. 81. Arizona and southwestern New Mexico. Range of *A. tephrodes*: ▲ var. *tephrodes*; △ var. *tephrodes* intermediate to var. *brachylobus*; ▴ var. *brachylobus*; ▴ var. *chloridae*; and ▴ var. *eurylobus*. Inset, southwestern Colorado and adjoining New Mexico. Range of *A. iodopetalus*.

(Gray) Rydb. in Bull. Torr. Club 52: 154. 1925 (excluding the supposed "type," *Palmer 102* in 1877). *Astragalus curtisii* (with short calyx-lobes, a mistranslation of *brachylobus*) Tidest. in Proc. Biol. Soc. Wash. 48: 40. 1935, and op. cit. 50: 20. 1937, a legitimate substitute (non *A. brachylobus* DC., 1825).

Astragalus pephragmenus (enclosed or girt, perhaps in allusion to the salient engirdling sutures of the pod) Jones in Zoë 4: 268. 1893.—"... on the summit of the Pinal Mountains, Arizona, May 26, 1890."—Holotypus, labeled "crest of the Pinals on road to Tonto Basin," POM! isotypi, GH, TEX, US!—*A. argophyllus* var. *pephragmenus* (Jones) Jones, Rev. Astrag. 208, Pl. 47. 1923. *Xylophacos pephragmenus* (Jones) Rydb. in Bull. Torr. Club 52: 151. 1925.

Astragalus remulcus (tow-rope, the allusion obscure) Jones in Proc. Calif. Acad. Sci. II, 5: 658. 1895.—"Rusby, no. 576, Bangharte's Ranch, Arizona, May, 1883..."—Holotypus, US! isotypus, NY!—*Xylophacos remulcus* (Jones) Rydb. in Bull. Torr. Club 52: 153. 1925.

Astragalus intermedius (intermediate, supposedly between *A. amphioxys* and *A. Bigelovii*) Jones in Proc. Calif. Acad. Sci. II, 5: 656. 1895.—"Arizona, Palmer. Type in National Herbarium."—Lectotypus, the flowering element of the type-sheet, US! The pods in a package associated with the holotypus represent *Oxytropis Lambertii* var. *Bigelovii*!—*A. phoenicis* (of Phoenix, Arizona) Jones, Contrib. West. Bot. 8: 12. 1897 ("*Phoenicis*"), a legitimate substitute (non *A. intermedius* Kar. & Kir., 1842).

Xylophacos lenophyllus (soft-leaved) Rydb., Fl. Rocky Mts., Ed. 2. 1126. 1922.—"Type collected in the vicinity of Flagstaff, Ariz., *MacDougal 27*."—Holotypus, NY! isotypi, GH, POM!

The ashen milk-vetch, *A. tephrodes*, is the commonest member of its section in Arizona, and over the central mountainous portion of the state the var. *brachylobus* is the characteristic astragalus of its type. At its northern limit the range of the variety slightly overlaps that of the related *A. argophyllus*, from which it may be distinguished by its slightly more numerous pairs of usually bicolored leaflets and by the longer and looser racemes. The pubescence-phases of var. *brachylobus*, however striking at first encounter, are no more than minor variants. The main types are as follows:

M. v. 1. Hairs all straight and appressed (var. *brachylobus*, sens. str.). Range of the variety.

M. v. 2. Hairs as in var. *brachylobus*, but the pod glabrous or early glabrate (*A. remulcus*). Yavapai County, Arizona, especially in the upper Verde Valley; the flowers sometimes of exceptionally brilliant purple (*Barneby 12,660*, RSA).

M. v. 3. Hairs spreading, largely straight, the calyx villous, the pod $\pm$ hirsutulous (*A. pephragmenus*). Gila County, Arizona, and vicinity. The herbage varies in the same colony from greenish-cinereous to silvery.

M. v. 4. Hairs spreading and incurved-ascending, fine and $\pm$ sinuous (*X. lenophyllus*). In pine forest, southern Coconino County, Arizona.

197b. ASTRAGALUS TEPHRODES var. TEPHRODES

Low and often relatively slender, the herbage pilosulous with ascending or incurved hairs up to (0.4) 0.5–0.75 mm. long, the leaflets glabrous or medially glabrescent above; stems 1–12 (15) cm. long; stipules 2–7 mm. long; leaves 4.5–10 (19) cm. long, with (11) 17–27 (31) obovate-cuneate or oblanceolate, obtuse, emarginate, or subacute, nearly always loosely folded leaflets 3–16 mm. long; peduncles 4–14 (17) cm. long; racemes (9) 11–20-flowered, the axis 2–6 (8.5) cm. long in fruit; calyx (5) 6.4–8.5 (9.2) mm. long, the tube (3.5) 4.5–6.8 (8) mm. long, 3.2–3.9 mm. in diameter, the teeth 1.2–2.2 mm. long; banner 11.8–17.5 mm., wings 11.8–17.5 mm., keel 10.2–14.5 mm. long; pod obliquely ovoid-acuminate, 1.3–2 cm. long, 5–8 mm. in diameter, the beak 3–6 mm. long, the valves thinly leathery, hardly rigid, not rugulose, densely pilosulous; ovules 26–31; seeds 1.8–2.2 mm. long.—Collections: 43 (v); representative: *Wootton in 1891* (NMC, POM), *in 1893* (NY), approximate topotypi; *Jones 26,182* (CAS, GH, POM); *Barneby 11,175* (CAS, RSA); *Rusby 90½* (GH, NY, POM); *Eggleston 19,947, 19,952, 19,953, 19,955* (NY).

Open stony hillsides, sandy gullied bluffs, and rolling plains, in oak brush, among junipers, in yucca-grassland, and ascending into the lower edge of the yellow pine forest, on granitic or volcanic bedrock, 4700–7000 feet, locally plentiful about the foothills of the Mogollon and Piños Altos Mountains in southwestern

New Mexico, east to the Organ Mountains on the Rio Grande, south just into northeastern Sonora; apparently isolated within the range of var. *brachylobus* in the Verde Valley, Arizona. Reports of var. *tephrodes* from western Texas and from near Albuquerque, New Mexico (Barneby, 1947) were based on flowering collections of *A. Waterfallii* and *A. feensis* respectively.—Map. No. 81.—April to June.

ASTRAGALUS TEPHRODES (ash-gray) Gray, Pl. Wright. 2: 45. 1853.—“Plains at the base of the Organ Mountains, New Mexico; April.”—Holotypus, collected by Charles Wright, April 30, 1852, GH!—*Tragacantha tephrodes* (Gray) O. Kze., Rev. Gen. 948. 1891. *Xylophacos tephrodes* (Gray) Rydb. in Bull. Torr. Club 52: 156. 1925. *A. tephrodes* var. *typicus* Barneby in Amer. Midl. Nat. 37: 465. 1947.

The center of dispersal of the relatively small-flowered typical variety of the ashen milk-vetch, var. *tephrodes*, lies on the watershed of the Gila River and the Rio Grande in southwestern New Mexico. It is abundant in northern Grant County, where it has been encountered at intervals during the past century by most of the many botanists active in the region of the Copper Mines, Silver City, and Mimbres; we thus possess an unusually complete herbarium record from its restricted area and presumably a detailed picture of variation in size of the flowers. Having collected var. *tephrodes* in seasons both of scanty and plentiful rainfall, I am fairly certain that flower-size in this species is affected to some degree by moisture available during the spring months. Thus it seems probable that plants from the upper Verde Valley in Arizona which are to be referred to var. *tephrodes* on the technical basis of small flower-size (mapped as intermediate to var. *brachylobus*) are likewise seasonal variants of var. *brachylobus*, the dominant form in Yavapai County. A plant from Seligman, *Eastwood 5935* (CAS), already singled out for special mention (Barneby, 1947, p. 466), points to the same conclusion. Here the flower is small, but the pod is both fleshy and glabrous, of a type known only in var. *brachylobus* and to be matched exactly only in large-flowered populations from the Verde Valley.

197c. *ASTRAGALUS TEPHRODES* var. *CHLORIDAE*

Tall, robust, strigulose with appressed or subappressed hairs up to 0.4–0.65 mm. long, the leaflets cinereous or greenish, pubescent on both sides or nearly glabrous above; *stems* 2–15 cm. long; *stipules* 2–15 mm. long, thinly strigulose or subglabrous dorsally; *leaves* 1–2.4 dm. long, with 19–25 rhombic, rhombic-ovate, -obovate, or oblanceolate, acute or rarely obtuse, flat leaflets 6–26 mm. long; *peduncles* stout, erect at anthesis, 1.3–4 dm. long, ultimately weighed down by the fruits; *racemes* 13–24-flowered, the axis (4) 7–20 cm. long in fruit; *calyx* 11.5–14 mm. long, pilosulous or loosely strigulose with black or mixed black and white hairs up to 0.45–0.65 mm. long, the tube 8.3–10.2 mm. long, 3.8–5.2 mm. in diameter, the teeth 2.1–3.8 mm. long; *banner* 16.8–20.4 mm., *wings* 16.1–20.2 mm., *keel* 15.2–18.2 mm. long; *pod* lance- or oblong-ellipsoid, 2.2–3.4 cm. long, 6–10 (12) mm. in diameter, the beak 3–6 mm. long, the valves stiffly leathery or subligneous, $\pm$ rugulose on the angles, strigulose-pilosulous; *ovules* 28–36; *seeds* 2.2–3.1 mm. long.—Collections: 6 (i); representative: *Lemmon 3354* (GH); *Ripley & Barneby 3377* (CAS, RSA); *Train 1236* (NA).

Open hillsides and sandy or gravelly washes in the foothills of desert mountains, with *Larrea* or junipers, 3000–4500 feet, locally plentiful but known only from the Cerbat Mountains, in northwestern Mohave County, Arizona, and from the Newberry Mountains, across the Colorado River in southern Clark County, Nevada.—Map No. 81.—Late March to May.

ASTRAGALUS TEPHRODES var. *CHLORIDAE* (Jones), comb. nov., based on *A. remulcus* var. *chloridae* (of Chloride, Arizona) Jones, Rev. Astrag. 210, Pl. 48. 1923 (“*Chloridae*”).—“Chloride, Ariz., among junipers on gravelly mesas.”—Holotypus, collected by Jones, April 14, 1903, POM! isotypi, GH, NY, TEX, US (2 sheets), WS! *Xylophacos chloridae* (Jones) Rydb. in Bull. Torr. Club 52: 153. 1925. *Astragalus chloridae* (Jones) Tidest. in Proc. Biol. Soc. Wash. 48: 40. 1923, and op. cit. 50: 20. 1937.

The Chloride milk-vetch is no doubt derived recently and directly from var. *brachylobus*,

presumably by means of a mutation which involved an adaptation to desert conditions together with a coarsening of the entire plant-body, and in particular a lengthening and thickening of the peduncles and raceme-axes. The variety, known for many years only from the Cerbat Mountains, was interpreted in my revision of the *Argophylli* as a *gigas* state of var. *brachylobus*; it has since been traced across the Colorado River into the southernmost corner of Nevada and has thus acquired a more substantial reality. At the same time it must be repeated that the smallest individuals of var. *chloridae* and the longest-pedunculate forms of var. *brachylobus* are almost identical, and the variety is distinguished by marked variational trends rather than by any one or any combination of differential characters.

197d. ASTRAGALUS TEPHRODES var. EURYLOBUS

Relatively coarse and robust, the herbage canescently pilosulous with sinuous and a few straight, ascending hairs up to 0.55–0.9 mm. long, the leaflets equally pubescent on both sides; *stems* angular, 2–9 cm. long; *stipules* 3–8 mm. long, all but the lowest pilosulous dorsally; *leaves* (7) 10–24 cm. long, with (19) 21–27 rhombic-obovate, broadly elliptic, or oblanceolate, obtuse or emarginate, flat leaflets 7–27 mm. long; *peduncles* 10–18 cm. long; *racemes* 18–26-flowered, the axis (2.5) 3.5–14 cm. long in fruit; *calyx* 10.8–12.2 mm. long, the cylindric tube 9–10.1 mm. long, 3.9–4.4 mm. in diameter, the teeth 1.8–2 mm. long; *banner* 19–21.8 mm., wings 19–20.8 mm., keel 17–19 mm. long; *pod* broadly oblong-ellipsoid, (2.3) 2.5–4 cm. long, 1–1.6 cm. in diameter, the beak 5–10 mm. long, the rigid, subligneous valves becoming strongly rugulose, densely strigulose.—Collections: 2 (ii); representative: *Ripley & Barneby 6416* (CAS, RSA).

On saddles and along gullied draws in low alkaline sandy-clay hills, 4650–4950 feet, locally abundant in the Needle Mountains, northeast of Caliente, Lincoln County, Nevada.—Map. No. 81.—April to June.

ASTRAGALUS TEPHRODES var. EURYLOBUS (with broad pod), var. nov., statura valde robusta, legumine maximo latissimo, ovulis magis numerosis, et seminibus majoribus (ut jam supra in clave diagnostica notatis) a caeteris speciei formis absimilis.—NEVADA: northeast of Caliente, Lincoln County, June 18, 1944, *Ripley & Barneby 6359*.—Holotypus, CAS! isotypi, GH, NY, RSA!

The surface topography of a great part of Lincoln County, Nevada, is sculptured out of calcareous bedrock, but the Needle Mountains are an exception, being raised on a pediment of soft, readily weathered pink sandstone which has broken down into an extensive area of sandy badlands. The var. *eurylobus* is locally plentiful on this formation and apparently confined to it. The variety is distinguished from var. *brachylobus* by its exceptionally large, pluriovulate pods, massive seeds, and canescently pilosulous foliage. The var. *brachylobus* is known to occur north of the Colorado River only in the upper Virgin Valley in southwestern Utah (*Springdale, Jones in 1894, POM*), but the specimens from this locality are as yet very meager and the station itself requires confirmation.

198. ASTRAGALUS IODOPETALUS

Low but relatively robust, diffuse and shortly caulescent or subcaulescent and loosely tufted, thinly to quite densely villous-villosulous with fine, straight or partly sinuous, loosely ascending hairs up to (0.7) 0.8–1.4 mm. long, the stems sometimes subglabrous, the herbage greenish-cinereous to silky-canescant, the leaflets bicolored, of brighter yellowish-green and medially glabrescent or nearly glabrous above; *stems* 1.5–10 (18) cm. long, prostrate and radiating, simple or few-branched near the base, the internodes either all concealed by stipules, or some of them developed and up to 0.5–2 (2.5) cm. long; *stipules* submembranous, becoming pallid and papery-scarious, several-nerved, broadly ovate- or triangular-acuminate, 2.5–12 cm. long, decurrent-amplexicaul around $\frac{1}{2}$ to $\pm$ the whole stem's circumference; *leaves* (4) 5–15 (20) cm. long, all petioled, with 17–31 (or in some early leaves, or in all leaves of some juvenile plants, only 7–15) oblanceolate, obovate, or elliptic, mostly obtuse or emarginate, flat or loosely folded leaflets 3–17 (20) mm. long, diminishing upward along the rachis; *peduncles*

commonly stout, (1.5) 3–10 cm. long, at anthesis incurved-ascending, prostrate in fruit; *racemes* rather closely (10) 12–20 (25)-flowered, the axis (1.5) 2–8 cm. long in fruit; *bracts* membranous, pallid with green midrib, broadly lanceolate or narrowly lance-caudate, 2.5–8.5 mm. long; *pedicels* ascending, straight or a little arched outward in age, at anthesis 1.3–2.3 mm., in fruit thickened, 2.2–3.6 mm. long; *bracteoles* 0; rarely a minute scale; *calyx* 10–15 mm. long, thinly villous-villosulous with loosely ascending, white (and sometimes a few shorter, black) hairs up to 0.8–1.3 mm. long, the oblique disc 1.4–2.2 mm. deep, the cylindric or deeply campanulate, submembranous, pallid or purplish tube (6.8) 7.5–10.5 mm. long, (2.8) 3.6–5 mm. in diameter, the subulate or lanceolate, herbaceous teeth 2.5–5.5 mm. long, the ventral pair commonly broadest and sometimes longest; *petals* bright reddish-violet, drying bluish or dark violet, the banner with a large, pallid lozenge in the fold (the color fugitive in drying); *banner* gently recurved through 40–50°, broadly rhombic-elliptic or -oblanceolate, shallowly notched, 17–23.5 mm. long, 7.4–11.8 mm. wide; *wings* 15.7–21 mm. long, the claws 7.7–10 mm., the linear-oblong or narrowly lanceolate, obtuse or truncate-emarginate, straight or distally incurved blades (8.9) 10–12.8 mm. long, (2.1) 2.4–3.9 mm. wide; *keel* 12–15.7 mm. long, the claws 7.4–10 mm., the half-obovate blades 5–7.2 mm. long, 2.8–3.8 mm. wide, abruptly incurved through 85–95° to the rounded apex; *anthers* (0.6) 0.65–0.9 mm. long; *pod* ascending (humistrate), obliquely ovate, lance-elliptic, oblong-elliptic, or lanceolate in outline, (1.7) 2–3 cm. long, 7–10 mm. in diameter, rounded or emarginate at base, straight or nearly so and obcompressed in the lower $\frac{1}{2}$ – $\frac{2}{3}$, thence contracted upward into a narrowly to broadly triangular, laterally compressed, stiffly cuspidate beak, the sutures both thick and prominent, but depressed (below the beak) and lying in a groove, the lateral angles very obtuse, the green, fleshy, glabrous valves becoming stiffly leathery or subligneous, brownish, or ultimately blackish, transversely rugulose-reticulate, often wrinkled lengthwise, not inflexed, or inflexed as a very narrow septum up to 1.7 mm. wide; *dehiscence* apical, through the gaping beak, after falling; *ovules* 30–44 (average $\pm$ 37); *seeds* brown or purplish, smooth or nearly so, sublustrous, 2–2.3 mm. long.—Collections: 12 (iv); representative: *C. F. Baker* 184 (G, GH, NY, RM, WS); *Ripley & Barneby* 5341 (CAS, NY, RSA), 10,218 (CAS, RSA); *Payson* 87 (GH, RM); *Barneby* 12,791 (CAS, RSA).

Dry stony hillsides and benches, commonly on granite, often about oak thickets, in oak-piñon forest, or among sagebrush, 6000–8100 feet, locally plentiful and not uncommon around the western and southern slopes of the Rocky Mountains in the valleys of the Gunnison, Mancos, and upper San Juan Rivers in southwestern Colorado, extending more rarely southeast to the west tributaries of the Rio Grande in Rio Arriba and Sandoval Counties, New Mexico.—Map No. 81.—May to July.

ASTRAGALUS IODOPETALUS (Rydb.) Barneby in Amer. Midl. Nat. 37: 471. 1947 (the combination incorrectly attributed to Greene), based on *Xylophacos iodopetalus* (with violet-colored petals) Rydb. in Bull. Torr. Club 52: 152. 1925.—“Type collected at Arboles, Colorado, June 1899, *Baker* 415 . . .”—Holotypus (*C. F. Baker* 415), NY! isotypi, G, GH, K, MO, ND, P, RM, US!—*A. iodopetalus* Greene ex Jones, Rev. Astrag., Index. 1923, in syn; Rydb., 1. c., in syn., nom. nud.

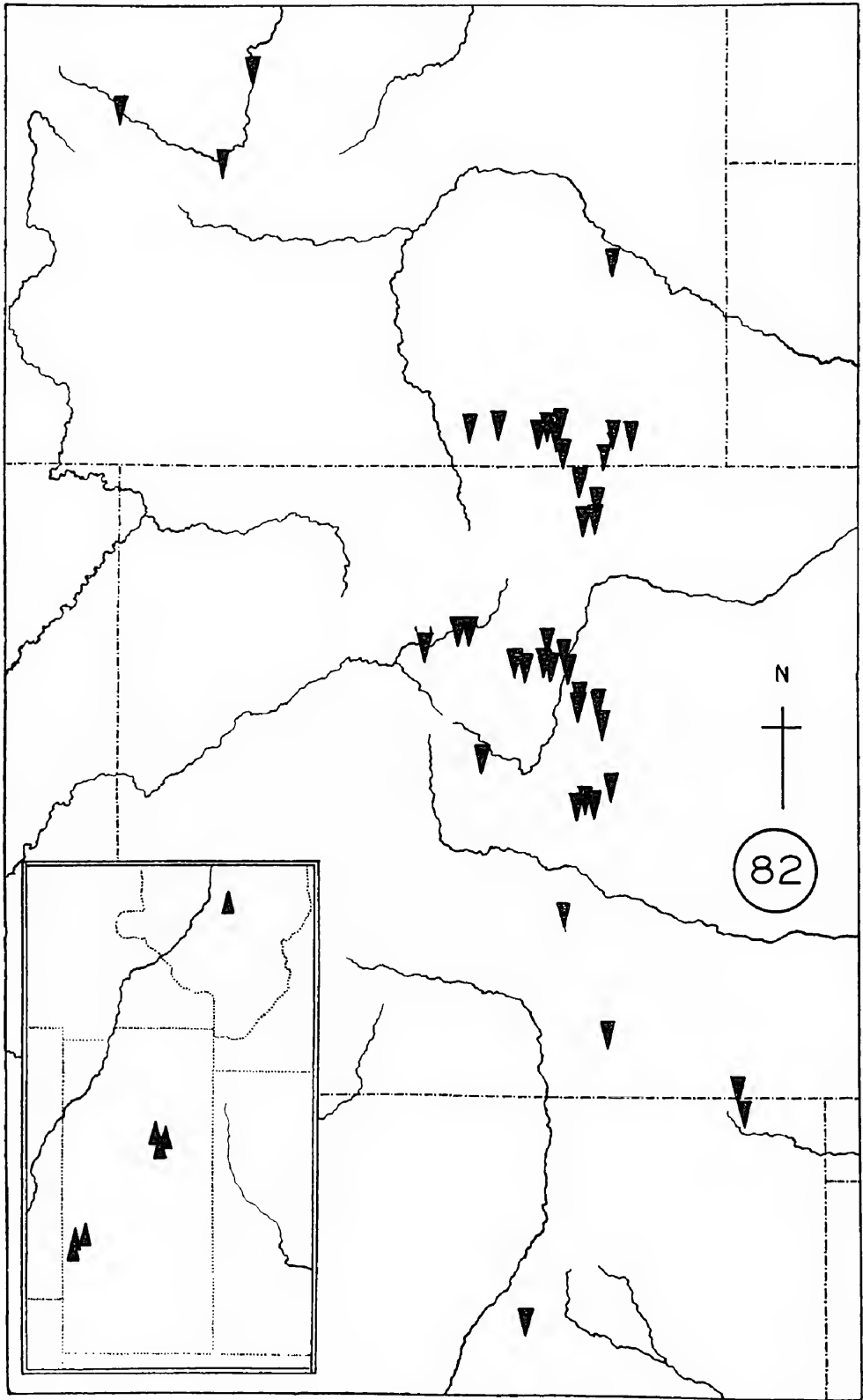
Xylophacos stipularis sensu Rydb., Fl. Rocky Mts. 504. 1917, quoad descr., non *A. arietinus* var. *stipularis* Jones.

The violet milk-vetch was christened *A. iodopetalus* by Greene in 1900, but the name was not published until many years later. The species, first described by Rydberg as *X. stipularis*, has nothing to do with the typus of the basonymic *A. arietinus* var. *stipularis*, our *A. naturitensis*, a species with fewer and smaller flowers and a shorter, narrower, strigulose pod. Jones (1923)

included it in his concept of *A. Shortianus*, from which it is readily distinguished by its smaller, thinner-textured fruit combined with 8-15 (not 3-8) pairs of leaflets in the mature leaves. The close affinity of *A. iodopetalus* is to *A. tephrodes* and in particular to the large-flowered var. *brachylobus*, from which it differs in no single, absolutely reliable character, although no difficulty is experienced in separating the two species in practice. The pod of *A. iodopetalus* is consistently hairless, and the teeth of the always villousulous calyx are relatively (mostly 3-5.5, rarely only 2.5 mm.) long. A rare form of var. *brachylobus* with glabrous pod is known to occur in westcentral Arizona, but the glabrous ovary is combined with a short-toothed, strigulose calyx. In the very few known instances where var. *brachylobus* has a villous calyx with teeth up to 2.8 mm. in length, the ovary and pod are strigulose. The resemblances between *A. iodopetalus* and *A. tephrodes* in general organization, habit of growth, and minor details of pubescence and coloring are many and unquestionably indicate a close relationship. Like *A. tephrodes*, the violet milk-vetch varies greatly in density of vesture, the herbage fluctuating from greenish to silky-canescient in stations only a few miles apart along the Gunnison River. The populations found in the oak brush are commonly but not always greener than those found at low elevations or in dry sites associated with sagebrush. Only the newly dried flowers of *A. iodopetalus* can be described as violet, the fresh color of the petals being a bright reddish-purple like that found in some forms of *A. tephrodes*.

199. ASTRAGALUS SHORTIANUS

Low, tufted, often quite amply leafy, essentially acaulescent, with knotty root-crown or shortly forking caudex, densely silky-strigulose or -strigose with fine, appressed or some narrowly ascending, straight or nearly straight hairs up to 0.75-1.25 mm. long, the calyx villous, the herbage silvery or rarely greenish, the leaflets commonly equally pubescent on both sides, sometimes more thinly so above; *stems* nearly always reduced to sessile crowns, exceptionally up to 2.5 cm. long, but the internodes all concealed by stipules; *stipules* thinly herbaceous becoming papery and brownish, several-nerved, lanceolate, lance-oblong, or -acuminate, the lowest sometimes ovate, (3) 5-12 mm. long, decurrent-amplexicaul around $\frac{1}{2}$ to the whole stem's circumference, free; *leaves* (4) 6-21 cm. long, with rather stiff, grooved petiole and 7-17 (19) obovate, rhombic-obovate, elliptic-ovate, rarely flabellate, obtuse, or rarely subacute, flat or loosely folded leaflets 5-20 (25) mm. long; *peduncles* usually stout, 2-15 cm. long, shorter (except at earliest anthesis) than the leaves, arcuate-procumbent or prostrate in fruit; *racemes* shortly but loosely (5) 7-16-flowered, the axis little elongating, 1-4 (6) cm. long in fruit; *bracts* membranous with green midrib, linear-lanceolate or -caudate, 4-10 mm. long; *pedicels* at anthesis slender, 1.6-2.8 mm. long, in fruit ascending or arched outward, thickened, (2) 3-4 mm. long; *bracteoles* usually 0, rarely 2, exceptionally conspicuous; *calyx* (9.4) 11-14.7 long, villous with loosely ascending or spreading hairs over 1 mm. long, the oblique disc 1.4-2 mm. deep, the membranous, usually purplish, cylindric or deeply campanulate tube (6.5) 7.6-9.8 mm. long, 3.6-4.8 mm. in diameter, the lance-subulate teeth 2.9-5.6 mm. long, the ventral pair commonly broader and often a trifle longer than the rest; *petals* pink-purple with pale claws and a pale lozenge in the fold of the banner; *banner* gently recurved through $\pm 40^\circ$, broadly spatulate to ovate-cuneate, (16) 19-22 mm. long, 7.5-11 mm. wide; *wings* nearly as long, (15) 17.2-20.1 mm. long, the claws (7.7) 8.6-10.3 mm., the lance-oblong, obtuse or truncate-emarginate blades (8.2) 9-11.6 mm. long, 2.8-3.9 mm. wide, slightly incurved in the distal half; *keel* (13) 15.5-17.2 mm. long, the claws (8) 9.3-10.3 mm., the half-obovate blades 6-7.7 mm. long, 3.2-4.2 mm. wide, rather abruptly incurved through $85-95^\circ$ to the bluntly deltoid apex; *anthers* 0.55-0.85 (0.9) mm. long; *pod* ascending (humistrate) obliquely ovoid or ellipsoid, (2) 2.5-4.5 cm. long, (8) 9-18 mm. in diameter, rounded or sometimes obtusely cuneate at base, obcompressed and nearly straight in the lower $\frac{2}{3}$, thence passing upward into a strongly incurved, deltoid- or lance-acuminate, laterally compressed, rigid beak, shallowly depressed-sulcate along both sutures or merely



flattened dorsally, the sutures both (but the ventral especially) prominent and cordlike, the green, fleshy, rather densely strigulose valves becoming woody or very stiffly leathery, brown, stramineous, or ultimately blackish, rugulose-reticulate, commonly not inflexed, but sometimes obscurely so, the septum forming a tubular cavity behind the ventral suture and extending inward $\pm$ the depth of the valve-wall, this 0.6–1.2 mm. thick when ripe; *dehiscence* apical, through the beak, tardy; *ovules* 33–54 (66); *seeds* brown or purplish-brown, pitted or wrinkled, (2) 2.6–3 mm. long.—Collections: 62 (x); representative: *A. Nelson* 7021 (GH, NY, POM, RM); *C. L. Porter* 2864 (GH, RM, TEX, WS, WTU); *Beetle* 1479 (CAS, NY); *Clokey* 3047 (CAS, NY, TEX); *Ripley & Barneby* 10,588 (CAS, RSA); *Eggleston* 20,170 (GH, NY); *Heller & Heller* in 1897 (OB, POM).

Prairies, dry hilltops, open stony ridges, or cobblestone bluffs, commonly on decomposed granite, occasionally on sandstone, coarse alluvia of mixed origins, and perhaps other bedrock, 5200–9000 feet, frequent and locally plentiful on the east slope and piedmont of the Rocky Mountains drained by the North Platte, South Platte, and Arkansas Rivers in southeastern Wyoming and Colorado, extending more rarely across the Divide in Colorado to the upper Grand River, south to the head of the Canadian River and the upper Rio Grande in northern New Mexico, and northwest to the Wind and Big Horn Rivers in westcentral Wyoming; an old report from the Black Hills (*Geyer*) requires confirmation; records from western Colorado (other than in Eagle and Grand Counties) were based on collections of *A. iodopetalus*.—Map No. 82.—May to July.

ASTRAGALUS SHORTIANUS (Charles Wilkins Short, 1794–1863) Nutt. ex T. & G., Fl. N. Amer. 1: 331. 1838.—“Rocky Mountains, towards the plains of the Oregon... *Nuttall*.”—Holotypus, labeled “*Astragalus* **Shortianus*. R. Mts. *Nuttall*,” BM!—*Tragacantha Shortiana* (Nutt.) O. Kze., Rev. Gen. 948. 1891. *Xylophacos Shortianus* (Nutt.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903. *A. Shortianus* var. *typicus* Barneby in Amer. Midl. Nat. 37: 454. 1947.

Astragalus humilis (of lowly growth) Geyer ex Hook. in Lond. Jour. Bot. 6: 211. 1847.—“On a stony ridge of the Black Hills ([*Geyer*] n. 215); upper Platte River, *Gordon*.”—Holotypus, a fruiting spm. dated July, 1845, *Geyer* 215, K! A second spm. numbered *Geyer* 215 but labeled “Missouri and Oregon, Rocky Mts.” (K) = *A. lotiflorus*.—The *Gordon* paratypus not found.—Non *A. humilis* M. B., 1808.

On the Laramie Plains and southward along the east slope of the Front Range as far as South Park, Short's milk-vetch is one of the common ornaments of spring. The large, rosy-purple flowers which are borne on short, subradical stalks expand rapidly with the approach of warm weather and fade before the loosely tufted foliage reaches its full development. The young leaves are silvery-silky and may remain so throughout the season, but often, especially when of ample size, turn greenish in age. Except for the villous-hirsute *A. Parryi*, the present species is the only member of its section with basifixed pubescence in its area of dispersal and is seldom misidentified. It has been confused only with *A. iodopetalus*, probably because the calyx of both is loosely pubescent and long-toothed, but *A. Shortianus* is easily distinguished by its fewer leaflets and ordinarily much larger or broader, thinly pubescent and not glabrous pod. The differential characters of the more nearly related *A. cyaneus* are mentioned below.

200. ASTRAGALUS CYANEUS

Low but robust, acaulescent or nearly so, with a thick, woody taproot and shortly forking, at length knotty caudex, strigulose throughout with straight, appressed or subappressed, filiform or slightly flattened hairs up to 0.4–0.75 mm. long, the herbage cinereous or greenish, the leaflets pubescent on both sides, but of a brighter green beneath the vestiture above; *stems* several, either reduced to crowns

or a little developed and up to 6 cm. long, but always shorter than the leaves, and the internodes not over 1.5 cm. long; *stipules* pallid, papery or early becoming so, several-nerved, lanceolate, triangular, or triangular-acuminate, 4–9 mm. long, decurrent around $\frac{1}{2}$ to the whole stem's circumference, free; *leaves* 6–18 cm. long, with stiff, grooved petiole and (15) 17–29 obovate to elliptic, obtuse, acute, or sometimes retuse, flat leaflets 4–19 mm. long; *peduncles* stout, (4) 6–13 cm. long, a little shorter than the leaves, ascending at anthesis, arcuately reclining or prostrate and radiating in fruit; *racemes* loosely (9) 12–22 (25)-flowered, the flowers loosely spreading or sometimes declined in age (but not characteristically nodding), the axis somewhat elongating, (2) 4–14 (20) cm. long in fruit; *bracts* thinly herbaceous becoming papery-membranous, lanceolate or linear-acuminate, 2.5–6 mm. long; *pedicels* erect or ascending, straight or nearly so, at anthesis 1–2.5 mm., in fruit clavately thickened, 2.5–4.5 mm. long; *bracteoles* 2, conspicuous or sometimes rudimentary; *calyx* 11.3–15 mm. long, strigulose with mixed black and white hairs, the oblique disc 2–2.8 mm. deep, the usually purplish, cylindric, or deeply and broadly campanulate tube 8.2–10.6 mm. long, 3.7–5.8 mm. in diameter, the subulate or lance-subulate teeth 2.3–4.6 mm. long; *petals* pink-purple, the banner with a pale, striate eye; *banner* gently recurved through $\pm 40^\circ$, spatulate-oblongate or ovate-cuneate, shallowly notched, 18–22 mm. long, 9.2–11 mm. wide; *wings* 17.9–21.9 mm. long, the claws 8.2–10.6 mm., the narrowly oblong, obtuse or obscurely emarginate, nearly straight blades 11.2–13.6 mm. long, 3.1–3.6 mm. wide; *keel* 16.3–18 mm. long, the claws 9–10.7 mm., the lunately half-elliptic or half-obovate blades 7.3–8.7 mm. long, 3.4–4 mm. wide, incurved through $90\text{--}95^\circ$ to the bluntly deltoid apex; *anthers* 0.65–0.8 mm. long; *pod* ascending (humistrate), obliquely oblong-ellipsoid, 2.5–5 cm. long, 7–13 mm. in diameter, gently incurved, obtuse at base, obcompressed through the lower $\frac{3}{4}$ or more and thence passing upward into a triangular- or lance-acuminate, laterally compressed, cuspidate beak, openly sulcate along both sutures, both sutures prominent and cordlike, the ventral one stouter, the green or purple-tinged, thickly fleshy, strigulose valves becoming rigidly woody, strongly reticulate, stramineous or brownish, 1–2 mm. thick when fully ripe, inflexed behind the dorsal suture to $\pm$ the depth of the valve-wall, the septum forming a narrowly tubular or triquetrous cavity the length of the pod-body, the sutures subcontiguous within, the cross-section therefore didymous; *dehiscence* apical, tardy, after falling; *ovules* (35) 39–48; *seeds* brown, smooth but dull, 2.7–3.4 mm. long.—Collections: 10 (iii); representative: *Heller & Heller* (approximate topotypi) in 1897 (MINN, NY, POM); *Ripley & Barneby* 7550 (CAS, RSA, UTC), 7560 (CAS, NY, RSA, UTC); *McKelvey* 2375 (GH).

Dry hillsides and gullied banks, in sandy or gravelly granitic soils, commonly associated with piñon and juniper, 6900–7300 feet, locally plentiful but uncommon, known only from the east side of the Rio Grande Valley in Santa Fe, Taos, and possibly northeastern Bernalillo Counties, New Mexico.—Map No. 82.—Late April to June.

ASTRAGALUS CYANEUS (dark blue, the petals sometimes turning so when dried) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 34. 1849.—“148. Sante Fe, on gravelly hills and low mountains among rocks.”—Holotypus, Fendler's *Pl. Novo-Mexicanae* No. 148, collected in 1847, GH! isotypi, NY, PH, US!—*Tragacantha cyanea* (Gray) O. Kze., Rev. Gen. 944. 1891. *Astragalus Shortianus* var. *cyaneus* (Gray) Jones, Contrib. West. Bot. 8: 5. 1898, & op. cit. 10: 65. 1902. *Xylophacos cyaneus* (Gray) Rydb. in Bull. Torr. Club 52: 154. 1925.

Astragalus jemensis (of the Jemez Mountains, source of a paratypus which represents *A. iodopetalus*) A. Nels. in Amer. Jour. Bot. 21: 574. 1934.—“Two sheets of Professor E. F. Castetter's No. 332, collected between Golden and Madrid (Jemez Mts.) N. M., May 23, 1930, are taken as the type.”—Holotypus, RM! isotypus, renumbered 6010, herb. Univ. New Mex!

The cyanic milk-vetch is a rather coarse astragalus, although handsome when in flower and memorable later on for its extremely large, thickly fleshy, ultimately woody pods. The history of *A. cyaneus* has been recounted elsewhere (Barneby, 1947, p. 455, as *A. Shortianus* var.), and it is shown there how a wide range based on misidentified material of related species was at one time attributed to what is now known to be a narrow endemic of the upper Rio Grande Valley. The cyanic milk-vetch is closely related to *A. Shortianus*, from which it is artificially separated in the subsectional key by the leaflet number, a useful but systematically unimportant character. It is distinguished further by the shorter, often flattened hairs of the herbage, the elongating raceme-axis, and the strigulose rather than villous calyx, features which combine with the numerous leaflets to create a wholly individual aspect, amply sufficient in the context of the section to maintain *A. cyaneus* in the rank of species. The main range of *A. Shortianus* lies well to the north of *A. cyaneus*, but it has been collected once near Santa Fe, the type-locality of its relative. The specimens from this outlying station are wholly typical, showing no suggestion of passage into *A. cyaneus*.

201. ASTRAGALUS COLUMBIANUS

Caulescent perennials, with woody taproot and thick, multicapital, knotty root-crown, strigulose with straight, appressed hairs up to 0.4–0.7 mm. long, the stems and herbage cinereous or the foliage greenish, the leaflets pubescent or subglabrate above; *stems* apparently diffuse, (0.8) 1.5–3.5 dm. long, leafless at base, simple or branching upward from near the base, floriferous from 1–3 nodes below the middle; *stipules* 1–6 mm. long, the lowest membranous, ovate, obtuse, more than semiamplexicaul, the upper ones narrower or shorter, deltoid, triangular, or lanceolate, herbaceous with membranous margins; *leaves* 3.5–5.5 cm. long, petioled, with 5–13 oblong-elliptic, narrowly oblanceolate, or linear-oblong, obtuse, or obtuse and mucronulate, flat or loosely folded leaflets 3–12 mm. long; *peduncles* ascending, rather stout, 1.2–2.5 cm. long; *racemes* subcapitately but loosely 2–10-flowered, the flowers ascending, the axis not or scarcely elongating, less than 1 cm. long in fruit; *bracts* thinly herbaceous becoming papery, lance- or deltoid-acuminate, 1–5 mm. long; *pedicels* ascending, at early anthesis 0.6–1 mm., in fruit greatly thickened and $\pm$ 1.5 mm. long; *bracteoles* 0–2, setaceous when present; *calyx* $\pm$ 11–11.6 mm. long, strigulose with appressed black hairs, the subsymmetric disc 1.2–1.4 mm. deep, the deeply campanulate, submembranous tube 6.6–7 mm. long, 3.8–4 mm. in diameter, the narrowly lance-subulate teeth 4–4.8 mm. long; *petals* apparently whitish; *banner* recurved through $\pm$ 35°, oblanceolate, 18.1–19.5 mm. long, 7.5–7.8 mm. wide; *wings* 18.5–19.5 mm. long, the claws 7.3–7.6 mm., the narrowly oblong, obtuse, straight blades 12.3–13 mm. long, 2.8 mm. wide; *keel* 13.1–13.6 mm. long, the claws $\pm$ 7.5 mm., the half-obovate blades $\pm$ 6.7 mm. long, 3.5 mm. wide, incurved through $\pm$ 85° to the bluntly deltoid apex; *anthers* 0.7–0.8 mm. long; *pod* apparently ascending and probably humistrate, sessile, narrowly oblong- or lance-ellipsoid, incurved through $\frac{1}{4}$ to over $\frac{1}{2}$ a circle, 2.5–4 cm. long, 8.5–10.5 mm. in diameter, obtuse or subtruncate at base, acuminate distally into an elongate, laterally flattened beak, otherwise dorsiventrally compressed, carinate ventrally by the suture, flattened or depressed dorsally, the lateral angles rounded but rugulose-reticulate when ripe, the green, fleshy, glabrous valves becoming subligneous, prominently cross-reticulate, not inflexed; *dehiscence* apical, through the beak, after falling; *ovules* 48–51; *seeds* brown or olivaceous, pitted and wrinkled, sublustrous, 2.5–3 mm. long.—Collections: 2 (o); representative: *St. John* 3342 (WS).

Rocky slopes at low elevations in the sagebrush zone, on basalt, known positively only from along the Columbia River above Priest's Rapids, Yakima County, Washington.—Not mapped—April to June.

ASTRAGALUS COLUMBIANUS (of the Columbia River), sp. nov., inter *Argophyllos* genuinos caulibus elongatis, foliolis paucis 2–6-jugis, pedunculis abbreviatis, floribus albidis notabilis. Legumen fere *A. argophylli* nisi glabrum, sed habitus in sectione peculiaris, forsan subsectionem

proprium sistens.—Perennis, diffusa, appresse strigulosa; *stipulis* liberis; *foliis* 3.5–5.5 cm. longis petiolatis, foliolis paucis angustis 3–12 mm. longis; *pedunculis* abbreviatis validis 1.5–2.5 cm. longis; *racemis* brevissime 2–10-floris; *calycis* strigulosi tubo profunde campanulato fere 7 mm. longo, dentibus lanceolatis 4–5 mm. longis; *petalis* albidis, iis *A. argophylli* et affinium similibus, vexillo circa 18–19.5 mm. longo; *legumine* sessili, deciduo, oblongo-ellipsoideo, infra rostrum incurvum de latere compressum obcompressum, valvulis carnosis glabris demum sublig-nosis ruguloso-reticulatis, haud inflexis; *ovulis* circa 50.—WASHINGTON: Walla Walla region, Washington Territory, June, 1883, *Brandegee* 720 and *Tweedy* 610 (apparently one collection twice numbered).—Holotypus, NY (herb. Canby.)! isotypi (*Brandegee* 720), GH, UC, US!

The Columbia milk-vetch was one of several interesting and rare plants collected in the Columbia Basin by T. S. Brandegee and Frank Tweedy while they were working under W. M. Canby for the Northern Transcontinental Survey, a biological investigation underwritten by the Northern Pacific Railway. The specimens of this astragalus have been passed over by students of the genus as representing *A. Casei*, a species known otherwise from farther south in western Nevada and adjoining California and easily distinguished by its much longer peduncles and open racemes of more numerous and pubescent pods. I have associated with the typus, which is in advanced fruit, a flowering collection from Priest's Rapids on the Columbia (cited above) which agrees in all important details comparable at such different periods of growth. A composite picture is thus built up of a singular astragalus which has all the technical attributes of the *Argophylli*, but a facies and habit of growth so peculiar that no immediate relationship within the section is apparent. The species is introduced at this place until more can be learned about it and its probable affinities. Except that it is hairless, the pod is quite like that of some forms of *A. argophyllus* or *A. tephrodes* var. *brachylobus*, and its mode of dehiscence after falling is characteristic of the present section. The more remarkable features of the species are its exceptionally well-developed stems, which apparently continue to elongate beyond the last peduncle after the flowers have faded; the very short peduncles and subcapitately few-flowered racemes; and the white or whitish flowers. At anthesis the plant could be confused in the Columbia Basin only with *A. vallis*, which is endemic to the Grand Canyon of the Snake River, and there is no sympatric species at all similar to it when in fruit. Modern collections, which should be sought along the banks of the Columbia upstream from the mouth of the Snake, are greatly desired.

202. ASTRAGALUS TIDESTROMII

Low, sometimes rather coarse, acaulescent or subacaulescent, perennial but of short duration, sometimes flowering the first season, with a taproot and ultimately a shortly forking but scarcely woody caudex, the herbage densely villous-hirsute and commonly also tomentose with incumbent or curly and $\pm$ entangled together with some longer, straighter, ascending and spreading hairs up to (0.75) 1–1.5 mm. long, the stems (when visible) white-felted, the leaves varying from white to greenish-gray, the inflorescence black-hairy; *stems* several, mostly reduced to obconic crowns beset with a thatch of imbricated stipules, sometimes a little developed and up to 4 (7) cm. long, then prostrate, and the internodes not over 1 cm. long; *stipules* thinly herbaceous becoming papery-membranous, triangular or lance-acuminate, 3–8 mm. long, decurrent around $\pm$ half the stem's circumference; *leaves* subradical (or appearing so), (3) 4–15 cm. long, with rather thick, stiff, recurving petiole and (7) 11–19 obovate-cuneate, broadly elliptic, or suborbicular, commonly obtuse or subtruncate, rarely subacute, flat, thick-textured leaflets 4–14 mm. long; *peduncles* stout, (2.5) 5–13 cm. long, shorter or slightly longer than the leaves, ascending at anthesis, arcuate-procumbent or prostrate in fruit; *racemes* loosely but shortly 5–16-flowered, the flowers loosely spreading-ascending, the axis somewhat elongating, (1) 2–7 cm. long in fruit; *bracts* membranous, lanceolate, 2.5–5.5 mm. long; *pedicels* ascending, straight, or in age a little arched outward, at anthesis 0.8–1.5 mm., in fruit thickened, 1.3–3.1 mm. long; *bracteoles* 2, sometimes conspicuous and up to 2 mm. long; *calyx* (5.5) 5.8–9.7 mm. long, villous-hirsute or villosulous with predominantly black hairs, the scarcely oblique disc 0.8–1.4 mm. deep, the membranous, deeply campanulate tube 5–7.3 mm. long, 2.7–4 mm. in diameter, the broadly subulate or triangular, obtuse teeth 0.8–2.7 mm. long, the ventral pair often longest and broadest; *petals* whitish

tinged with sordid lavender, the keel and wings tipped with dull dark purple; *banner* recurved through $\pm 40^\circ$, broadly oblanceolate or rhombic-elliptic, shallowly notched, 12–17.7 mm. long, 6.5–9.5 mm. wide; *wings* (11.6) 12.3–17 mm. long, the claws 5.5–8.7 mm., the linear-oblong or narrowly lanceolate, obtuse, straight or nearly straight blades 7.2–9.5 mm. long, 2.3–2.9 mm. wide, rather gently incurved through (85) 95° to the blunt apex; *anthers* 0.5–0.65 mm. long; *pod* ascending or incurved-ascending (humistrate), variable in size and outline, the basic outline obliquely lance-acuminate, (1.5) 2–5.5 cm. long, 6–16 mm. in diameter, obtusely cuneate or shortly acuminate and laterally compressed at base, thence obcompressed-quadrangular and incurved or inwardly hooked through $\frac{1}{4}$ to nearly $1\frac{1}{4}$ circles, passing distally into the usually long, narrowly triangular-acuminate, laterally compressed, rigid beak, bicarinate by the prominent thickened sutures but the ventral suture depressed and lying in an open groove, the lateral angles formed by transverse dilation of the valves rather narrow but obtuse, the green, fleshy valves strigulose with appressed or incumbent, sometimes curly hairs up to 0.5–0.7 mm. long, becoming stiffly leathery or subligneous, brownish-stramineous, coarsely cross-reticulate and rugulose on the angles, not inflexed; *dehiscence* apical, through the beak and part way down through the ventral suture, after falling; *ovules* 26–49; *seeds* light or yellowish-brown, often purple-speckled, pitted, sometimes greatly distorted by crowding, 2.5–3.6 (4) mm. long.—Collections: 24 (v); representative: *Clokey* 8596 (NA, SMU, TEX, WIS, WS); *C. B. Wolf* 10,354, 10,581 (CAS); *Ripley & Barneby* 6389 (CAS, RSA).

Open gravelly hillsides, outwash fans, gravelly and sandy playas in the foothills of calcareous desert mountains, commonly with *Larrea*, but ascending into the juniper belt, (2000) 2400–5000 feet, locally plentiful and rather frequent in the eastern Mohave Desert, in particular about the Spring, Charleston, and Desert Ranges in Clark County, Nevada, and the Clark, Kingston, and Nopah Ranges in eastern San Bernardino and extreme southeastern Inyo Counties, California; somewhat isolated in the western Mohave Desert at the mouth of Cushenbury Canyon, San Bernardino Mountains.—Map No. 85.—March to May.

ASTRAGALUS TIDESTROMII (Rydb.) Clokey in Madroño 6: 214. 1942, based on *Xylophacos Tidestromii* (Ivar Tidestrom, 1864–1956) Rydb. in Bull. Torr. Club 52: 155. 1925.—“Type collected in Charleston Mountains, Nevada, May 27, 1919, *Ivar Tidestrom* 9661 . . .”—Holotypus, collected at “Wilson’s Ranch, on mesa at base of the Charleston Mountains,” US! isotypus (fragm.), NY!

Astragalus amphioxys $\times$ *Layneae* Jones, Rev. Astrag. 215. 1923, as to description, but the collections cited (“Chimihuevis Mts., Arizona [south of Franconia] and my No. 5010 from the copper mine west of St. George, Utah . . .”) are forms of *A. amphioxys*. Specimens agreeing with the description were collected by Jones in Clark County, Nevada, in 1905 (Good Springs) and 1906 (Indian Springs); either would serve if needed as typus of the supposed hybrid.—*A. Marcusjonesii* (Marcus Eugene Jones, 1852–1934, preeminent student of North American *Astragalus*) Munz in Leaflet West. Bot. 3: 50. 1941, in large part, excl. typus and syn. *Xylophacos melanocalyx*.

The Tidestrom milk-vetch has been introduced at this point because it possesses the technical attributes, in particular the basifixed vesture, of the genuine *Argophylli*; but its closest affinity in the section is probably with *A. amphioxys*, a species of subject. *Missourienses*, characterized by dolabriform hairs. It resembles *A. amphioxys* in habit of growth, and the pods are almost identical in size, in form, in curvature, and in the dorsiventral compression of the middle part which passes into lateral compression toward either end. The rather coarse villous-tomentose vesture of *A. Tidestromii* and the proportions of its relatively small, pale or luridly bilobed flowers are the features in which it differs most obviously from *A. amphioxys*; these are at the same time astonishingly similar, even in fine detail, to the comparable features of *A. Layneae*. The resemblance in flowering material is so great that *A. Tidestromii* has repeatedly been confused with *A. Layneae* in herbaria, even though the latter’s solitary stems arising from slender, horizontal rhizomes and (eventually) its bilocular pod are fundamentally different. It is not surprising, however, that the earliest discoveries of the Tidestrom milk-vetch were

interpreted as representing a hybrid *A. amphioxys* $\times$ *Layneae*, a hybrid which seemed all the more plausible in that it was found close to the line where the ranges of the supposed parents were known to converge. As the dispersal of *A. Tidestromii* has become more fully known and its habits studied in the field, its status as a self-perpetuating species has become established beyond any chance of controversy. Nevertheless its neat combination of morphological features of two distantly interrelated and wholly dissimilar astragali, and this within a restricted region abutting on the ranges of both, is bound to excite speculation as to its origin in the past through hybridization and subsequent recombination of diverse heredities. The situation is similar to that described under *A. riparius* in sect. *Reventi-arrecti*.

The ecology of the three species involved in this provocative triangle is of considerable interest, for it goes far to explain the mutually exclusive ranges of, at least, *A. Tidestromii* and *A. Layneae* (see map 85). So far as known, *A. Layneae* avoids sedimentary bedrock and is certainly calcifuge. In contrast *A. Tidestromii* occurs nowhere except on limestone or on out-wash fans built up out of calcareous debris, a fact dramatically illustrated by its disjunct occurrence on the calcareous island in Cushenbury Canyon and its absence from the granitic deserts intervening between the San Bernardino Mountains and the Kingston massif. The widely dispersed *A. amphioxys* is indifferent to the nature of the bedrock over most of its range, but toward its western limit occurs most frequently on sedimentary formations, both sandstone and limestone. It impinges on the range of *A. Tidestromii* in the foothills of the Spring and Charleston Mountains, but barely comes into contact with *A. Layneae* in the neighborhood of Kingman, Arizona, the only known spot where a hybrid involving the two species could be expected to occur at the present time.

Although described only in recent years, the Tidestrom milk-vetch was first collected in 1844, by Fremont (NY) on his second expedition, very likely in the neighborhood of the Vegas wash.

LVI (ii). Subsectio PSEUDARGOPHYLLI

Growth-habit and basifixed vesture of the preceding subsect. *Argophylli*; *stipules* all free; *flowers* of subsect. *Argophylli*, the keel 10.5–19 mm. long; *pod* similar, but triquetrously compressed, the stiffly papery or leathery valves inflexed as a complete septum; *ovules* 27–43.—Spp. 2, xerophytes of central New Mexico to western Texas and adjoining Mexico.

ASTRAGALUS sect. ARGOPHYLLI subsect. PSEUDARGOPHYLLI, subsect. nov., omnibus cum *Argophyllis* genuinis congruentis nisi legumine trigono, dorso sulcato, prorsus biloculari.—Sp. typica: *A. Waterfallii* Barneby.

The two species of this small, perhaps artificial group are perfect *Argophylli* up to the bilocular, trigonous, and dorsally grooved pod, a feature which seems to have been derived comparatively recently from the unilocular condition, as in the cases of *A. anisus* and *A. leucolobus* discussed below. Each of the two species resembles to a singular degree one variety of the geographically vicariant *A. tephrodes*, and in the flowering condition plants of *A. Waterfallii* and *A. feensis* are difficult or impossible to distinguish from *A. tephrodes* var. *brachylobus* and var. *tephrodes* respectively.

Key to the Species of Subsect. Pseudargophylli

1. Herbage strigulose; *flowers* large, the calyx 10–14 mm., the banner 19.5–23 mm., the keel 14.5–19 mm. long; *pod* mottled; Pecos and Rio Grande Valleys in s.-e. New Mexico and w. Texas, s. (an unknown distance) into n. Mexico 203. *A. Waterfallii*
1. Herbage villous-villosulous; *flowers* smaller, the calyx 5.2–8 mm., the banner 13–16 mm., the keel 10.5–13 mm. long; *pod* greenish turning stramineous; e. side of Rio Grande Valley, centr. New Mexico 204. *A. feensis*

203. ASTRAGALUS WATERFALLII

Low, tufted, subcaulescent or shortly caulescent, with a thick, woody tap-root, strigulose nearly throughout with straight or nearly straight, appressed and often a few narrowly ascending hairs up to 0.3–0.75 mm. long, the herbage gray or silvery in youth, but the leaflets bicolored, brighter green and glabrous above; *stems* several, 0.5–7 (9) cm. long, simple or spurred near the base, the internodes all concealed by stipules, or if somewhat developed not over 1 (1.5) cm. long; *stipules* membranous with green midrib, pallid or early becoming so, ovate-triangular or triangular-lanceolate, 2.5–8 mm. long, decurrent around $\frac{1}{2}$ or a

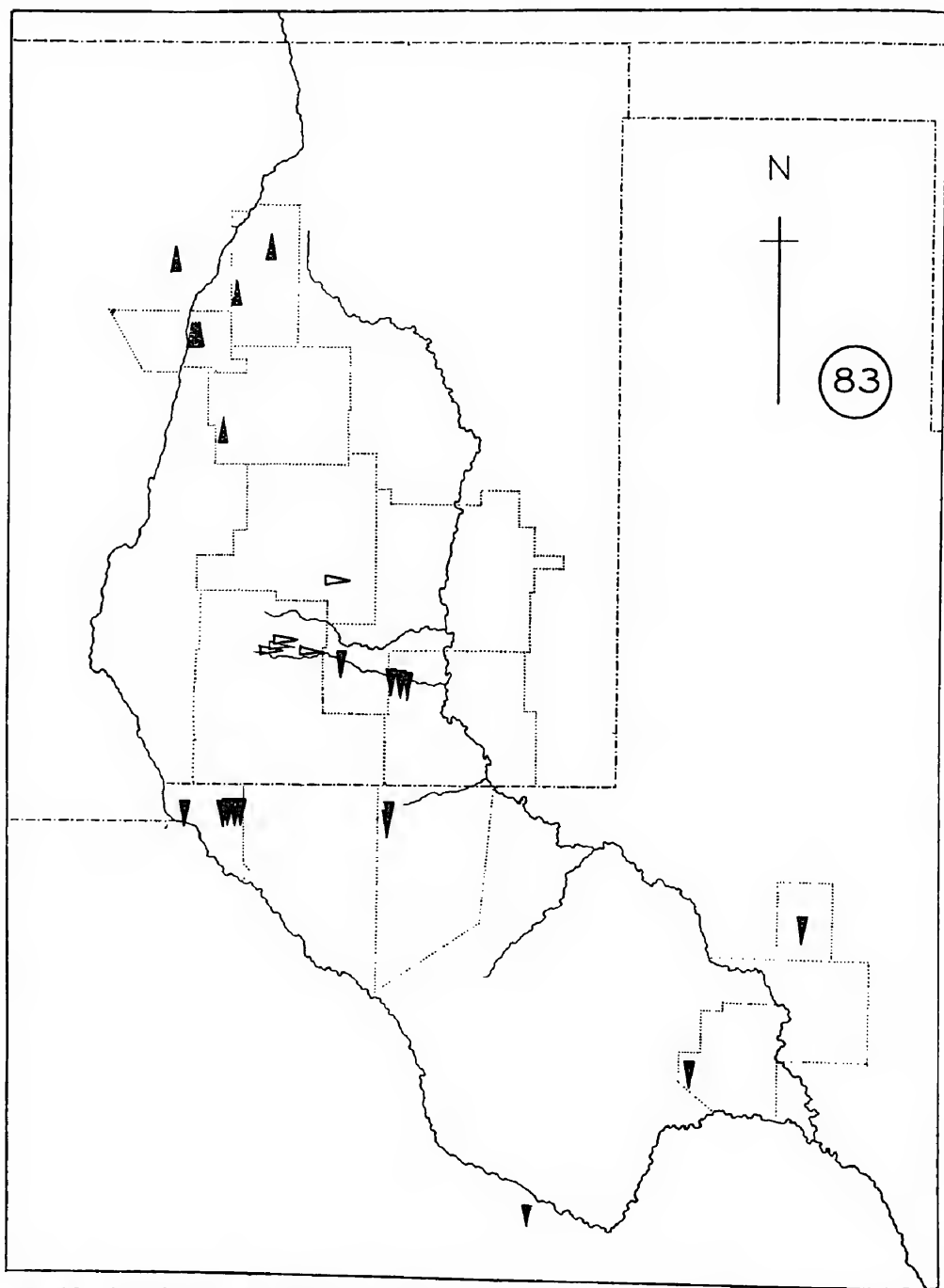
little more of the stem's circumference; *leaves* appearing subradical, 3–10 (12.5) cm. long, with slender petiole and 9–25 elliptic, oval-elliptic, ovate-oblong, or oblanceolate, obtuse or subacute, loosely folded or finally flat leaflets 3–16 mm. long; *peduncles* rather stout, (1.5) 3–11 cm. long, ascending at anthesis, prostrate in fruit; *racemes* shortly but loosely (4) 6–18-flowered, the axis little elongating, (0.5) 1–4 cm. long in fruit; *bracts* membranous, ovate, ovate-acuminate, or lanceolate, 2–7 mm. long; *pedicels* ascending, at anthesis 1–2 mm., in fruit somewhat thickened, 1.5–3.5 mm. long; *bracteoles* either setaceous, or lance-ovate and up to 3.5 mm. long; *calyx* 10–14 mm. long, strigulose or rarely subpilosulous with pale, dark, or mixed hairs, the fleshy, somewhat oblique disc 1.3–2.6 mm. deep, the broadly cylindric, purplish tube 7.9–11.6 mm. long, 3.7–5 mm. in diameter, the subulate or triangular-subulate teeth 1.3–3 (4) mm. long; *petals* purple with paler claws, the banner with a large, pallid lozenge in the fold; *banner* gently recurved through $\pm 40^\circ$, oblanceolate or oval-oblanceolate, 18.5–23 mm. long, (6.4) 8–11 mm. wide; *wings* 17.2–22.7 mm. long, the claws 8–11.4 mm., the narrowly lance-oblong, obtuse blades 10.2–12.8 mm. long, 2.1–3.5 mm. wide, rather abruptly tapering and a trifle incurved above the middle; *keel* 14.5–19 mm. long, the claws 7.5–10.9 mm., the lunately oblanceolate blades 7.4–9.6 mm. long, 2.8–3.6 mm. wide, incurved through $85\text{--}95^\circ$ to the blunt apex; *anthers* (0.6) 0.65–0.8 (0.9) mm. long; *pod* ascending (humistrate), narrowly oblong-ellipsoid or somewhat clavately ellipsoid, a trifle incurved, (1.7) 2–3.8 cm. long, 5–8 mm. in diameter, cuneate or cuneately tapering at base, abruptly acute and cuspidate at apex, obtusely trigonous and at the same time a little compressed, carinate ventrally by the suture, the lateral angles rounded, the dorsal face shallowly sulcate, the fleshy, purple-mottled, strigulose valves becoming stiffly papery or leathery, in age brownish, finely reticulate and also wrinkled lengthwise, inflexed below the beak as a complete or subcomplete septum 2.3–4.3 mm. wide; *dehiscence* apical, basal, and through the length of the ventral suture; *ovules* 28–38 (43); *seeds* yellowish- or ocher-brown, sometimes purple-speckled, lustrous but pitted or wrinkled, 2.3–3.2 mm. long.—Collections: 14 (ii); representative: *W. R. & J. P. Moore* 33 (SMU, WS); *Warnock* 5366 (SMU, SRSC); *McVaugh* 8143 (DS, SMU, TEX); *Barneby* 11,155 (CAS, NY, OKLA, RSA, US).

Stony hillsides and open slopes, on limestone, commonly in yucca-grassland, 2700–5300 feet, perhaps higher southward, locally plentiful in scattered stations within the drainage of the middle and lower Pecos River, from the rolling east foothills of the Sacramento Mountains, New Mexico, southeast to Reagan and Terrell Counties, Texas, and west in Texas to the Franklin and Hueco Mountains in El Paso and adjoining Hudspeth Counties, south into extreme northern Chihuahua and possibly Coahuila, but the Mexican range quite uncertain.—Map No. 83.—March to June.

ASTRAGALUS WATERFALLII (Urnaldy Theodore Waterfall, 1910—) Barneby in Leaf. West. Bot. 7: 31. 1953.—“NEW MEXICO: 21 miles west of Artesia, Eddy County, April 12, 1953, *U. T. Waterfall* 10,615 . . .”—Holotypus, OKLA! isotypi, CAS, MO, RSA, US!

In southeastern New Mexico and western Texas, no other astragalus, with the exception of the strongly caulescent, glabrous-ovaryed *A. crassicaupus* and *A. gypsodes*, has flowers as large as those of the Waterfall milk-vetch, which is distinguished further from the *Crassicaupi* found within its range of dispersal by its slenderly ellipsoid or clavately ellipsoid, handsomely red-mottled pod. The species first became known to me through a poor specimen collected close to Dr. Waterfall's type-locality in 1917 by Marion L. Campbell (CAS), but there are collections extant from Mexico dating back fifty and eighty years. A plant collected in Sierra Rica, Chihuahua, by Havard (*No. 31*, GH) in 1881 is probably the earliest. A second, *Purpus* 4671 (UC), collected in October 1910 at 7–8000 feet elevation in the Sierra de Parras, seems to belong to *A. Waterfallii*, but fruiting material is required before the identity of the specimen

can be settled. A third collection, also in flower, was made by H. H. Rusby in August, 1880, on the Jornada del Muerto, the desert plain lying between the Rio Grande and the White Sands in southcentral New Mexico. Rusby's plant (WS, apparently not duplicated in herb. Rusby. at NY) was determined as depauperate *A. Waterfallii*, but the calyx is scarcely 8 mm., the banner only about 16 mm., and the keel 13 mm. long. Further collections from the region may show this form to be distinct.



Map No. 83. Rio Grande and Pecos Valleys, eastern New Mexico and western Texas. Range of  *A. feensis*; of  *A. Waterfallii*; and of  *A. neomexicanus*.

204. *ASTRAGALUS FEENSIS*

Low, loosely tufted, subcaulescent or shortly caulescent, perennial but of short duration, sometimes flowering the first season, with a slender taproot and (in older plants) a shortly forking caudex, densely villous or villosulous with narrowly ascending or partly spreading, straight and sometimes a few sinuous hairs up to 0.7–1.2 mm. long, the stems and herbage canescent or silvery, the leaflets glabrous or medially glabrescent above; *stems* few or several, simple, 1–6 (10) cm. long, prostrate or ascending, sometimes reduced to crowns, the internodes either all concealed by stipules, or some of them a little developed and up to 1 (2.5) cm. long; *stipules* membranous, pallid, becoming papery-scarious, ovate, deltoid, or triangular-acuminate, 2.5–6 mm. long, decurrent around slightly more to much less than $\frac{1}{2}$ the stem's circumference; *leaves* (2.5) 3.5–9.5 cm. long, all petioled, with (7) 9–17 (19) broadly oblanceolate to obovate or cuneate-obovate, obtuse or truncate, commonly folded leaflets 3–13 mm. long; *peduncles* 2.5–9.5 cm. long, ascending at anthesis, arcuate-procumbent or prostrate in fruit; *racemes* loosely but shortly (6) 8–15-flowered, the axis becoming (0.5) 1–3 cm. long in fruit; *bracts* membranous, ovate-acuminate, long-ciliate, 1.5–3.5 mm. long; *pedicels* ascending or a little arched outward in age, at anthesis 0.7–1.5 mm., in fruit somewhat thickened, 1–2 mm. long; *bracteoles* 0; *calyx* 5.2–8 mm. long, villosulous with white hairs, the slightly oblique disc 1–1.5 mm. deep, the membranous, deeply campanulate or subcylindric tube 4.6–6.5 mm. long, 2.7–3.2 mm. in diameter, the subulate or triangular-subulate teeth 1.1–2 mm. long; *petals* reddish-lilac or pale purple, the banner with a whitish, striate lozenge in the fold; *banner* gently recurved through $\pm 40^\circ$, 13–16 mm. long, the long-tapering claw expanded into an ovate, oval, or subrhombic, notched blade 7–9 mm. wide; *wings* 12–14 mm. long, the claws 5.6–7.5 mm., the lance-oblong or oblong, obtuse, nearly straight blades 7–9 mm. long, 2.1–2.5 mm. wide; *keel* 10.4–13 mm. long, the claws 5.3–7 mm., the lunately half-obovate or -elliptic blades 5.6–7 mm. long, 2.5–2.8 mm. wide, gently incurved through $45\text{--}85^\circ$ to the bluntly deltoid apex; *anthers* 0.5–0.7 (0.75) mm. long; *pod* ascending (humistrate), narrowly ellipsoid to lance-ellipsoid, lunate or crescentically incurved through $\frac{1}{2}$ -circle, (1.3) 2–3 cm. long, 3.5–6 (7) mm. in diameter, narrowly cuneate but ultimately obtuse at base, more gradually tapering distally into the laterally compressed, deltoid-acuminate, sharply cuspidate beak, elsewhere triquetrous, carinate ventrally by the suture, the lateral faces shallowly concave along the common suture and then low-convex toward the obtuse lateral angles, the dorsal face widely but deeply sulcate, the fleshy, greenish valves strigulose with subappressed hairs up to 0.35–0.5 mm. long, becoming stramineous, prominently reticulate, inflexed as an incomplete or nearly complete septum 1.3–2.3 mm. wide, this commonly broadest above the middle and tapering proximally; *dehiscence* apical, through the gaping, unilocular beak, after falling; *ovules* 27–36; *seeds* pale pinkish- or yellowish-brown, rugulose-punctate but somewhat lustrous, 2–2.4 mm. long.—Collections: 6 (iii); representative: *Ripley & Barneby 7558* (CAS, GH, NY, POM, RM, RSA, UTC), *8337* (CAS, RM, RSA, UTC); *Castetter 6030* (NMEX).

Open sandy benches and gravelly hillsides among junipers, on granitic bed-rock, 5100–6200, (perhaps 6950) feet, local but forming colonies, known only from the east side of the Rio Grande Valley from near Santa Fe south to Albuquerque and the Manzanita Mountains, in Santa Fe, Bernalillo, and Tarrant Counties, New Mexico.—Map No. 83.—April to early June.

ASTRAGALUS FEENSIS (of Santa Fe) Jones, Contrib. West. Bot. 8: 20. 1898 ("*Feensis*").—"Dry gravelly hills, Santa Fe, New Mexico, May 28, 1847, Fendler No. 151... No. 16966 of the Engelmann collection."—Holotypus, MO!—*Hamosa feensis* (Jones) Rydb. in N. Amer. Fl.

24: 421. 1927. *Astragalus Sanctae-Fidei* Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 218. 1941, an illegitimate substitute.

Unlike the majority of Fendler's *Plantae Novo-Mexicanae*, the No. 151 was a fragmentary unicate bearing ripe fruits but no flowers and it was passed over unidentified, even though briefly mentioned, by Gray in *Plantae Fendlerianae*. The specimen was misdetermined by Sheldon (in herb.) as *A. missouriensis* and finally described by Jones as a new species supposedly allied to *A. Parryi*. Until recently *A. feensis* was known only from this unique specimen, more than a century having elapsed between Fendler's sojourn in New Mexico and the rediscovery of the species. In the absence of flowers, the affinities of *A. feensis* could only be surmised, and it was misplaced by Jones (1923) in his sect. *Malaci* and by Rydberg (1929) in the equivalent sect. *Malacae* of *Hamosa*. The Santa Fe milk-vetch is certainly not closely akin either to the emmenoloboid *A. malacus*, in which the pod is shortly stipitate, or to *A. Andersonii*, which has connate stipules; the similarity in the compression and curvature of the legume of these three species is fortuitous and has no phylogenetic significance. As mentioned already, flowering plants of *A. feensis* are so nearly identical with some forms of *A. tephrodes* at the same stage of growth that separation of the two is virtually impossible until the pod is far enough developed to show the beginnings of a septum. The imagination is staggered by the number of coincidences in the course of convergent evolution required to create two organisms so similar in fine structural detail except for the fruit. The origin of the bilocular *A. leucolobus* from the unilocular *A. Purshii* of subsect. *Eriocarpi* is self-evident and has never been questioned. Here surely is a parallel case.

LVI (iii). Subsectio NEOMEXICANI

Growth-habit of the caulescent genuine *Argophylli*, but no acaulescent state known; *flowers* nodding at full anthesis; *calyx-tube* strongly oblique at base, gibbous behind the pedicel; *plants* flowering in summer and fall.—Sp. 1, xerophyte, of the mountains of southcentral New Mexico.

ASTRAGALUS sect. ARGOPHYLLI subsect. NEOMEXICANI, subsect. nov., cum *Argophyllis* genuinis omnino congruentes nisi floribus nutantibus, calyce basi pone pedicellum gibbo, et inflorescentia serotina, sed his notulis distinctissimi.—Sp. typica: *A. neomexicanus* Woot. & St.

205. ASTRAGALUS NEOMEXICANUS

Low but relatively coarse, robust, leafy, with a taproot and superficial crown or shortly forking caudex, strigulose and pilose-pilosulous nearly throughout with shorter incurved or curly together with longer, fine, straight, ascending hairs up to 0.7–1.1 mm. long, the herbage green, greenish-cinereous, or canescent when young, the leaflets somewhat bicolored, brighter green and medially glabrescent or nearly glabrous (exceptionally pubescent) above; *stems* several, diffuse and incurved-ascending, (0.7) 1–3 dm. long, simple or spurred at 1–3 nodes preceding the first peduncle, floriferous from near or commonly from below the middle; *stipules* submembranous becoming papery and brownish, (3) 6–12 mm. long, embracing $\frac{1}{3}$ – $\frac{2}{3}$ the stem's circumference, the ovate or lanceolate blades mostly erect; *leaves* (5) 8–23 cm. long, shortly petioled, with (19) 23–39 (43) lance-ovate or rhombic-elliptic and acute or subacute, more rarely oblong-obovate and obtuse or emarginate, flat or loosely folded leaflets (3) 5–20 mm. long, diminishing upward along the rachis; *peduncles* rather stout, incurved-ascending, (5) 6–15 cm. long, shorter than the leaf; *racemes* (10) 12–24-flowered, rather dense in early anthesis, the flowers nodding, secund, somewhat retrorsely imbricated, becoming looser and interrupted, the axis elongating, (3) 5–12 cm. long in fruit; *bracts* submembranous, narrowly lance-acuminate or -caudate, 3–10 mm. long; *pedicels* ascending or a trifle arched outward in age, at anthesis 1–2 mm., in fruit a little thickened, 2.5–3.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 9.6–13 mm. long, loosely strigulose-villosulous with shorter, incurved, usually black, together with longer, ascending, usually white hairs (but these sometimes all of either color), the strongly oblique disc 1.2–1.6 mm. deep, the deeply campanulate to broadly cylindric, submembranous, pinkish- or dark reddish-purple tube 6.8–

9.4 mm. long, 3.9–5 mm. in diameter, obliquely truncate or dorsally gibbous at base, the lanceolate or triangular-lanceolate teeth 2.8–4.4 mm. long, the ventral pair commonly shortest and broadest, more rarely longest; *petals* dull pinkish-lavender, or greenish-purple, or bright magenta-purple; *banner* broadly oblanceolate or rhombic-oblanceolate, notched, 15.7–19.2 mm. long, (6) 6.5–8.8 mm. wide, sigmoidally arched, the blade recurved through 45°, the claw proximally incurved to conform with the saccate calyx-tube; *wings* 13.7–16 mm. long, the claws (6.3) 6.5–7.6 mm., the oblong-oblanceolate or narrowly elliptic, obtuse or (when broad) obliquely emarginate, slightly incurved blades 7.3–9.3 mm. long, 2.8–3.3 mm. wide; *keel* 11.3–12.7 mm. long, the claws (6.3) 6.5–7.6 mm., the half-obovate blades 5–6.1 mm. long, 2.8–3.3 mm. wide, abruptly incurved through 95° to the broad, blunt apex; *anthers* (0.55) 0.6–0.85 mm. long; *pod* either loosely pendulous from ascending peduncles or, more commonly, humistrate and ascending, obliquely oblong-ellipsoid, gently incurved, (1.7) 2–3.3 cm. long, 7–11 mm. in diameter, cuneate at base, contracted distally into a short, deltoid, laterally compressed beak, otherwise obcompressed, the ventral suture prominent but commonly depressed, the dorsal face either plano-convex or shallowly and openly sulcate, the lateral angles rounded, the green, fleshy, strigulose valves becoming leathery, stramineous, ultimately brownish, transversely reticulate and wrinkled lengthwise, not inflexed, or inflexed as a very narrow septum ± 1 mm. wide, the cross-section subdidymous; *dehiscence* apical and part way downward through the ventral suture, the dorsal suture also splitting but not separating; *ovules* 28–33; *seeds* soot-black, smooth, dull, 2.6–3.3 mm. long.—Collections: 8 (ii); representative: *Waterfall* 12,974 (RSA); *Barneby* 12,871 (CAS, GH, NY, OKLA, K, RSA, US), 12,886 (CAS, NY, RSA, US); *E. R. Schaffner* 2071, 2073, 2075 (RM).

Dry gravelly banks, stony hillsides, and talus under cliffs, sometimes on road cuts, in piñon and juniper forest, or ascending into open places in yellow pine forest, 6850–8450 feet, local, White and Sacramento Mountains, southern Lincoln and Otero Counties, New Mexico.—Map No. 83.—July to October, flowering after summer rains.

ASTRAGALUS NEOMEXICANUS (of New Mexico) Woot. & Standl. in Contrib. U. S. Nat. Herb. 16: 136. 1913.—“Type in U. S. National Herbarium, no. 690254, collected in James Canyon in the Sacramento Mountains near Cloudcroft, Otero County, July 23, 1899, by E. O. Wooton.”—Holotypus, US!—*Pisophaca* (?) *neomexicana* (Woot. & Standl.) Rydb. in N. Amer. Fl. 24: 329. 1929.

This singular astragalus was described from young specimens and, in absence of fully formed fruits, its affinities long remained doubtful. Jones (1923, p. 196) placed it in sect. *Flexuosi* (= our *Scytocarpi*), remarking that “it seems to be *A. gracilentus*.” It was perhaps in deference to this evaluation that Rydberg (l.c.) referred it with a note of interrogation to the equivalent genus *Pisophaca*. The detached pod of *A. neomexicanus* might be likened to that of *A. Hallii* var. *fallax* (part of *A. gracilentus* sensu Jones), but it is naturally deciduous, and the free stipules and superficial root-crown are at variance with all the genuine *Scytocarpi*. Except for the dorsally gibbous calyx and nodding flower, the New Mexico milk-vetch has everything in common with sect. *Argophylli*, and the pod has proved to be quite similar in form and dehiscence to that of several members of the typical subsection, in particular *A. tephrodes*. The morphological characters of *A. neomexicanus*, as well as its adaptation to a summer-blooming period, which are foreign to sect. *Argophylli*, are shared by a sympatric species, *A. giganteus*. The latter differs importantly from *A. neomexicanus* in its yellowish petals, erect stems, and especially in the erect, persistent, fully bilocular pod of woody texture. However the pubescence of *A. neomexicanus*, which is composed of shorter, incurved hairs mixed with longer, ascending ones, is also reminiscent of *A. giganteus*, even though in the latter the long hairs are spirally twisted. In brief, *A. neomexicanus* appears to occupy a position intermediate in at least some notable technical characters between sect. *Argophylli* and the sympatric, monotypical sect. *Gigantei*. It may represent a selection from the progeny of a hybrid *A. giganteus* $\times$ *tephrodes*.

LVI (iv). Subsectio NEWBERRYANI

Strictly acaulescent, the stems reduced to thick, obconic crowns tufted on the root-crown and beset with a thatch of closely imbricated stipules and (nearly always) stiff, recurving petioles or petiole-bases; *vesture* basifixed (in *A. loanus* and *A. musiniensis*, sometimes partly or obscurely dolabriform); *stipules* free; *leaflets* few (1) 3–13 (15); *flowers* shortly or subumbellately racemose, few, ordinarily large, ascending; *petals* purple, whitish tinged with lilac, or whitish; *pod* obliquely ovoid-acuminate, obcompressed proximally, contracted distally into a laterally compressed, incurved beak, the fleshy valves becoming leathery, sub-ligneous, or alveolate-spongy when ripe, not inflexed, strigulose, hirsutulous, hirsute, or hirsute and tomentose; *ovules* (20) 27–54.—Spp: 5, xerophytes, of the Great and Colorado Basins (eastern Oregon to southeastern California, Utah, and northwestern New Mexico), one extending southeast across the Divide into the Rio Grande Valley, northern New Mexico.

ASTRAGALUS sect. ARGOPHYLLI subsect. NEWBERRYANI Jones, Rev. Astrag. 201, in clave. 1923 ("*Newberryenses*").—Sp. typica: *A. Newberryi* Gray.

Xylophacos sect. *Eriocarpi* Rydb. in Bull. Torr. Club 52: 144, in clave. 1925.—Sp. typica: *X. Watsonianus* (O. Kze.) Rydb. = *A. Newberryi* Gray.

The chief features common to the *Newberryani* are the obligate acaulescence and the hard, thickened root-crown, often beset with stiff, marcescent petioles, which cannot ordinarily be flattened in the press and thus form characteristically bulky specimens. The few, nearly always large flowers and the relatively few leaflets are also noteworthy.

Key to the Species of Subsect. Newberryani

1. Pod densely long-hirsute with stiff, commonly lustrous hairs up to (2) 2.5–4.5 mm. long, sometimes also densely tomentulose, the valves becoming stiffly papery, leathery, or woody, but never alveolate-spongy, the ripe walls less than 1 mm. thick; range of the subsection, but very rare e. of the Sevier River and Wasatch in Utah (2)
2. Vesture of the leaves basifixed; *valves* of the solid or scarcely tumid pod stiffly leathery or woody when ripe; species widely dispersed (3)
3. Peduncles and petioles beset with loosely ascending, straight or straightish hairs; *petals* purple, sometimes pale; *pod* obliquely ovoid, the valves concealed by the tomentulose under-vesture; widespread 209. *A. Newberryi*
3. Peduncles (except immediately beneath the flowers) and petioles strigose with straight, appressed hairs; *petals* commonly ochroleucous faintly tinged with leaden-lavender, exceptionally purple; *pod* lance-ovoid, the stiffly leathery valves not or scarcely concealed by an under-vesture of shorter curly hairs, commonly only hirsute with lustrous, ultimately tawny hairs; central Utah 210. *A. eurekaensis*
2. Vesture of the leaves dolabriform, the hairs laterally attached even though only just above the base; *valves* of the hollow, moderately inflated pod stiffly papery when ripe; central Utah, rare 208. *A. loanus*
1. Pod strigulose or hirsutulous, more rarely villous (never tomentulose), the hairs up to 2 mm. long, but if over 1 mm. long, then the valves thickly fleshy becoming alveolate-spongy and at least 1.5 mm. thick when ripe (and then of the Colorado Basin in e. Utah) (4)
4. Stipules membranous, pallid except for the green midrib; *pod* strigulose with appressed hairs up 0.5–0.7 mm. long, the valves leathery but much less than 1 mm. thick when ripe; local in n.-e. Nye County, Nevada 206. *A. uncialis*
4. Stipules firm, early becoming papery and brownish, prominently several-nerved; *pod* thinly hirsutulous to villous-hirsute, the ascending hairs up to 0.6–2 mm. long, the thickly succulent valves becoming alveolate-spongy in age, 1.5–2 mm. thick when ripe; e.-centr. Utah 207. *A. musiniensis*

206. ASTRAGALUS UNCIALIS

Dwarf, densely tufted, composed of 1–several sessile crowns arising from a

woody taproot or shortly forking caudex beset with a thatch of stipules and leaf-bases, the herbage silvery-strigose with rather coarse, lustrous, straight, appressed and often a few ascending hairs up to (0.85) 1–1.5 mm. long; *stipules* membranous, pallid with green midrib, 3–6.5 mm. long, almost fully amplexicaul but free, the imbricated blades deltoid-ovate or lanceolate, pubescent dorsally, or the innermost ones subglabrous, all ciliate; *leaves* 1.5–7.5 cm. long, with slender, wiry petioles and 3–5 sessile but articulate, oblanceolate, elliptic, or narrowly obovate, acute or subobtuse, flat leaflets 5–17 mm. long, the 3 upper ones approximate and subpalmately disposed, the lower pair, when present, rather remote; *peduncles* scapose, shorter than the leaves, 0.5–3.5 cm. long, ascending at anthesis, prostrate in fruit; *racemes* subcapitately 1–3-flowered, the flowers suberect, the axis not over 3 mm. long in fruit; *bracts* membranous, ovate or lance-ovate, 1.5–3.5 mm. long; *pedicels* ascending, at anthesis 1.5–2.5 mm., in fruit a trifle thickened, 2.5–3 mm. long; *bracteoles* usually 0, minute when present; *calyx* 12–16 mm. long, strigulose with white or sometimes also a sprinkling of black hairs, the oblique disc 1.4–2 mm. deep, the cylindric, straight or slightly decurved, pallid or purplish tube 10.2–13 mm. long, 3.8–5.2 mm. in diameter, the lance-subulate teeth 1.8–3.5 mm. long; *petals* bright pink- or violet-purple, the banner with a pale, striate lozenge in the fold; *banner* recurved through $\pm 45^\circ$, oblanceolate, notched, 24.5–32 mm. long, 10–12.5 mm. wide; *wings* as long or a little shorter, 24.5–28.5 mm. long, the claws 12.5–14.8 mm., the narrowly oblong or lance-oblong, obtuse, straight or slightly incurved blades 13–15 mm. long, 2.6–3.3 mm. wide; *keel* 21.5–24.5 mm. long, the claws 11.5–14 mm., the narrowly obovate-elliptic blades 10–11.5 mm. long, 3.5–4.1 mm. wide, very gently incurved through $\pm 45^\circ$ to the broadly rounded apex; *anthers* 0.7–0.85 mm. long; *pod* ascending (humistrate), obliquely oblong- or lance-ellipsoid, (2) 2.5–3 cm. long, 8.5–12 mm. in diameter, obtuse or shallowly retuse at base, very strongly obcompressed and nearly straight in the lower $\frac{2}{3}$, thereafter abruptly incurved into a broad, deltoid- or triangular-acuminate, laterally compressed beak, ventrally and sometimes also dorsally (but there less strongly) carinate by the salient but depressed sutures, the thinly fleshy valves strigulose with appressed hairs up to 0.6–0.7 mm. long, becoming leathery, brownish-stramineous beneath the silvery vesture, finely cross-reticulate and a little rugulose on the lateral angles, not inflexed; *dehiscence* apical, through the beak, tardy; *ovules* 38–54; seeds (immature) orange-brown, apparently smooth, ± 2 mm. long.—Collections: 3 (iii); representative: *Ripley & Barneby 4421* (CAS, GH, RSA), *4423* (RSA).

Dry knolls and gullies, in sandy or gravelly, alkaline soils derived from comminuted limestones, 5300–6050 feet, rare and local, known only from the foothills of the White Pine and Pancake Ranges, northeastern Nye County, Nevada.—Map No. 79.—May and June.

ASTRAGALUS UNCIALIS (inch-high) Barneby in Leaflet West. Bot. 3: 101, Pl. opp. p. 108, fig. E. 1942.—“NEVADA: . . . in the vicinity of Currant, northeastern Nye Co., alt. 5300 ft., 22 May 1941, *Ripley & Barneby No. 3563*.”—Holotypus, CAS! isotypus, RSA!

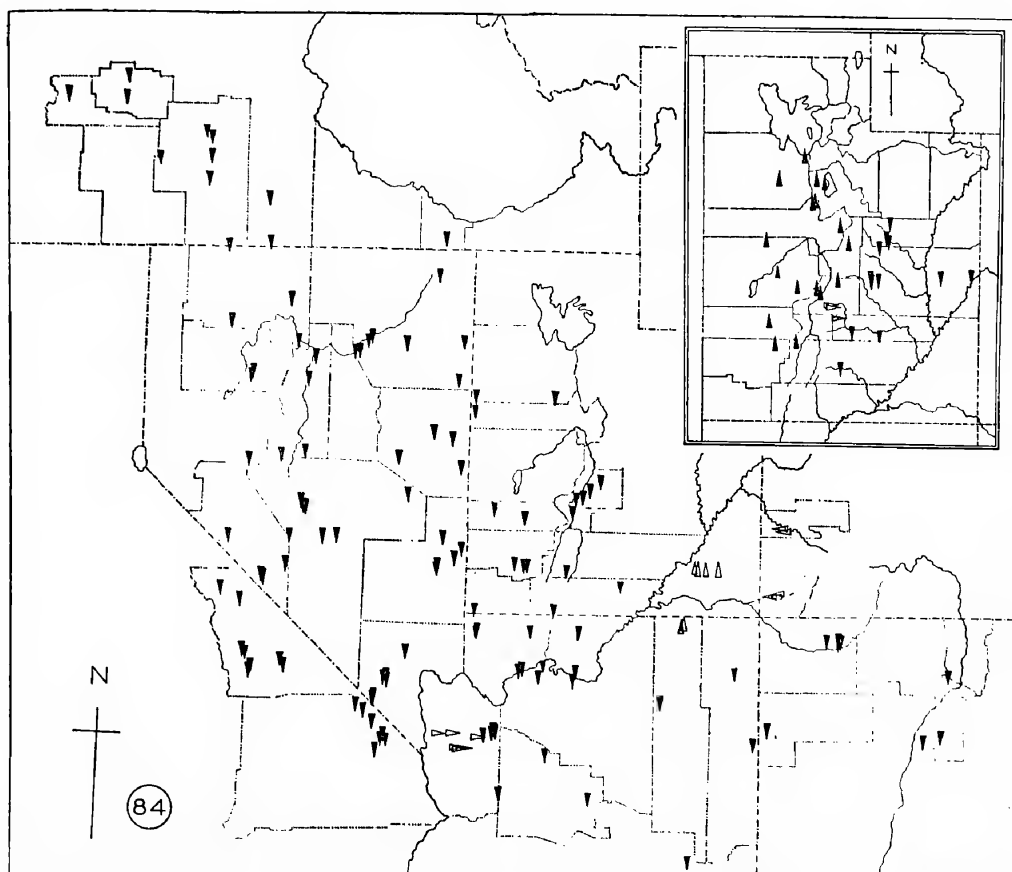
The Currant milk-vetch, *A. uncialis*, is one of the most strongly characterized and one of the most ornamental dwarf astragali discovered in recent years. It should be easily recognized by its silvery 3–5-foliolate leaves gathered into radical tufts and by its narrow, long, and showy purple flowers which seem quite disproportionately large for the plant's diminutive stature. The species is apparently related, although not very closely, to *A. musiniensis*, from which it differs in its smaller, ordinarily narrower leaflets and in its appressed-pubescent pod of much thinner texture and narrower outline. The species seems to be truly rare as well as local, for careful search in favorable years has turned up only a few plants in each of the two known stations. It will no doubt be found elsewhere on the limestones of eastcentral Nevada, a sector of the Great Basin of which the botanical riches are poorly known.

207. *ASTRAGALUS MUSINIENSIS*

Perennial but sometimes flowering the first season, with a long, woody tap-root, the few or solitary stems reduced to thick, scarcely elongating, cylindric or turbinate crowns beset with imbricated stipules and stiff, recurved leaf-bases, the herbage densely strigulose, strigose, or subpilose with straight or nearly straight, appressed and some narrowly ascending, basifixed (or a few basally spurred and incipiently dolabriform) hairs up to (0.5) 0.6–1.25 (1.4) mm. long, the leaflets gray or silvery, equally pubescent on both sides; *stipules* firmly papery, becoming brown, prominently nerved, glabrescent in age, (3.5) 5–10 mm. long, semiamplexicaul, with erect, lanceolate or lance-acuminate blades; *leaves* radically tufted, (1.5) 2.5–12 cm. long, erect and spreading on stiff petioles, with 3–5 (or in some early leaves only 1) elliptic, oblong-elliptic, lanceolate, or broadly rhombic, acute or subacute, flat, subsessile but readily disjoining leaflets (0.5) 1–3 (3.5) cm. long, these approximate on a rachis 2–12 mm. long or, when only 3, subpalmate; *peduncles* stout, 1.5–6 cm. long, shorter than the leaves, ascending at anthesis, arcuate-procumbent in fruit; *racemes* loosely but shortly 1–4 (6)-flowered, the axis scarcely elongating, 2–10 mm. long in fruit; *bracts* firmly papery, ovate or lance-acuminate, 1.6–4 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1.2–2.5 mm., in fruit thickened, 1.6–4 mm. long; *bracteoles* 0; *calyx* 13–15.5 mm. long, strigose-pilose with subappressed or loosely ascending, black and white or all white hairs up to 1–1.8 mm. long, the oblique disc 1.5–2 mm. deep, the cylindric (sometimes upwardly a little constricted) tube 10.5–12.7 mm. long, 3.5–5.2 mm. in diameter, the subulate teeth (1.5) 2–3.6 (4) mm. long; *petals* pink-purple, the claws and the striate lozenge in the fold of the banner paler or whitish; *banner* gently recurved through $\pm 40^\circ$, broadly oblanceolate-spatulate, shallowly notched, 22–28 mm. long, 8.5–14 mm. wide; *wings* 21–25 mm. long, the claws 12–14.2 mm., the narrowly oblong or lance-oblong, obtuse, straight or distally incurved blades 10–12.2 mm. long, 2.4–3.6 mm. wide; *keel* (18) 19–22.7 mm. long, the claws 11.8–15 mm., the gently lunate blades 7.6–9 mm. long, 3–4 mm. wide, gradually incurved through $45\text{--}85^\circ$ to the blunt, rounded apex; *anthers* (0.65) 0.7–0.9 (1) mm. long; *pod* ascending (humistrate), obliquely ovoid-acuminate, (1.5) 2–3.6 cm. long, (0.8) 1–1.7 cm. in diameter, obcompressed and shallowly sulcate ventrally in the lower $\frac{1}{2}\text{--}\frac{2}{3}$, thence incurved through $40\text{--}90^\circ$ into the laterally compressed, triangular or triangular-acuminate beak, the succulently fleshy valves at first thinly hirsutulous to silvery-villous-hirsute (the hairs ascending and up to 0.6–2 mm. long), often less densely pubescent or glabrescent in age, ultimately brownish-stramineous with purple- or pink-suffused cheeks, the ripe walls differentiated into a thin, smooth or faintly reticulate (perhaps eventually exfoliating?) exocarp, a thin endocarp, and a mesocarp of cellular-spongy tissue at least 1.5–2 mm. long (thickest toward the lateral angles of the fruit), not inflexed; *dehiscence* apical, through the beak, after falling, *ovules* (33) 36–53; *seeds* chestnut-brown, pitted, wrinkled, or both, scarcely lustrous, 2.8–3.2 mm. long.—Collections: 14 (viii); representative: *Jones* (from Spring Glen) in 1896 (GH, NY, POM); *Ripley & Barneby* 8611 (CAS, NY, RSA, UTC); *Barneby* 12,697 (CAS, NY, RSA), 12,750 (CAS, RSA).

Gullied knolls and stony clay benches among junipers, on shale, sandstone, or gravelly alluvia, 4700–7000 feet, uncommon but well distributed around the west and north periphery of the Colorado Basin south of Tavaputs Escarpment, in the drainage of the upper Price, San Rafael, Fremont, Escalante and Grand Rivers, eastcentral Utah.—Map No. 84.—May and June.

ASTRAGALUS MUSINIENSIS (of Musinia Peak, a summit of the Wasatch over 20 miles w. of the type-station) *Jones* in Proc. Calif. Acad. Sci. II, 5: 671. 1895 ("*Musiniensis*").—"No. 5454a.



Map No. 84. Utah, Nevada, and parts of adjoining states. Range of *A. Newberryi*: $\blacktriangledown$ var. *Newberryi*; and $\diamond$ var. *Blyae*; of $\diamond$ *A. naturitensis*; and of $\triangle$ *A. monumentalis*. Inset, upper right, Utah. Rnge of $\blacktriangledown$ *A. musiniensis*; of $\blacktriangle$ *A. eurekaensis*; and of $\diamond$ *A. loanus*.

June 18, 1894, two miles south of Ferron, Utah, on clay slopes, at about 6000° alt."—Holotypus, POM!—*Xylophacos musiniensis* (Jones) Rydb. in Bull. Torr. Club 40: 49. 1912 ("*musiniensis*").

Astragalus musiniensis var. *newberryoides* (resembling *A. Newberryi*) Jones, Rev. Astrag. 212. 1923 ("*Newberryioides*").—"A common form from Thompson's Spring and the San Rafael Swell in Utah . . ."—No spm. found labeled "Thompson's Spring"; lectotypus, collected May 12, 1914, in the San Rafael Swell, Jones, POM!

Like the preceding species, with which it has much in common up to the fruit, *A. musiniensis* is a sharply differentiated astragalus. The pithy texture of the ripe pod, formed as sap is withdrawn from the large cells of the mesocarp, is reminiscent of *A. Chamaeleuce* which occurs in similar environment but only rarely in the same range. As compared with the Ferron milk-vetch *A. Chamaeleuce* has a slender root-crown devoid of marcescent petioles, more numerous, smaller leaflets, and a less prominently beaked, purple-spotted or -mottled pod. Young, acaulescent, flowering specimens of *A. Chamaeleuce* can be distinguished by the dolabriform attachment of all the hairs. Jones (1923, p. 212) pointed out the many features common to *A. musiniensis* and *A. Newberryi*. They differ consistently in characters of the pod already stressed in the subsectional key, and are vicariant in range. The following species is somewhat intermediate between them.

208. ASTRAGALUS LOANUS

Dwarf, tufted, truly acaulescent, with the habit, thickened root-crown, and persistent leaf-bases of *A. Newberryi*, but the herbage densely strigose and ascending-pilose with rather stiff, lustrous hairs up to 1–2 mm. long affixed laterally just

above the base, the leaves silvery-silky, the inflorescence loosely silky-pilose; *stipules* 5–9.5 mm. long, broadly lanceolate, several-nerved, long-ciliate, at first thinly pubescent dorsally but becoming glabrate, ultimately papery and brownish; *leaves* 2.5–9 cm. long, with stiff but rather slender petioles and 3–9 (11) elliptic, lance-elliptic, or rhombic-oblong, acute or subacute, flat leaflets 6–16 mm. long; *peduncles* stout, 1–2.5 cm. long, much shorter than the leaves, ascending at anthesis, recurved in fruit; *racemes* loosely but subcapitately 2–7-flowered, the flowers ascending, the axis scarcely elongating, not over 1 cm. long in fruit; *bracts* membranous, lanceolate, 2.5–6 mm. long; *pedicels* at anthesis slender, about 1.2 mm. long, in fruit thickened and up to 1.8 mm. long; *bracteoles* 0; *calyx* 10.7–14 mm. long, rather thinly ascending-hirsute with black and white, basifixed hairs, the slightly oblique disc 1.3–1.6 mm. deep, the membranous tube 8.5–10.7 mm. long, 3.5–4 mm. in diameter, exactly cylindric or slightly dilated upward and thus cylindro-vase-shaped, the subulate teeth 1.7–4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* white, the keel tipped with pale lavender; *banner* recurved through $\pm 40^\circ$, spatulate-oblong, 21–22 mm. long, 9 mm. wide; *wings* 19.5–20.6 mm. long, the claws 12–12.2 mm., the narrowly lance-oblong, obtuse, slightly incurved blades 8.6–9.7 mm. long, 2.2 mm. wide; *keel* 18–18.5 mm. long, the claws 12–12.2 mm., the lunately half-circular blades 6.3–6.8 mm. long, 3.1–3.5 mm. wide, incurved through 95° to the bluntly deltoid apex; *anthers* 0.6–0.7 mm. long; *pod* loosely ascending (humi-strate), sessile on the slightly produced receptacle, obliquely ovate- to broadly lance-acuminate in profile, (1.8) 2–4 cm. long, 0.9–1.9 cm. in diameter, obtuse at base, obcompressed and ventrally sulcate in the lower $\frac{2}{3}$, contracted distally into an incurved, triangular, laterally flattened beak, the cavity hollow due to moderate or pronounced inflation, the valves when first formed fleshy and ± 0.5 mm. thick, becoming stiffly papery when ripe, hirsute with lustrous, spreading, basifixed hairs up to 2–2.5 mm. long, the vestiture not concealing the green or at length brownish-stramineous surface, the endocarp not at all inflexed; *dehiscence* apical, through the beak, after falling; *ovules* 28–38; *seeds* unknown.—Collections: 4 (i); representative: *L. F. Ward* 225 (US); *B. F. Harrison* 7366 (BRY); *Ripley & Barneby* 8603 (RSA).

Open hillsides among sagebrush, in gravelly volcanic (or perhaps sometimes calcareous) soils, 6000–8900 feet, apparently rare, known only from the divide between the Sevier and Fremont Rivers in Sevier and western Wayne Counties, Utah.—Map No. 84.—May and June.

ASTRAGALUS LOANUS (of Loa, Utah), nom. et stat. nov., based on *A. Newberryi* var. *Wardianus* (Lester Frank Ward, 1841–1913) Barneby in Amer. Midl. Nat. 37: 481. 1947.—“Canyon east of Glenwood, Sevier County, Utah, *L. F. Ward* No. 223 in 1875 . . .”—Holotypus, mounted on the same sheet as the holotypus of *A. Newberryi*, collected June 16, at 6000 ft., GH! isotypi, K, NY, US (at “7000 ft.”)!

The Loa milk-vetch is similar in most respects to *A. musiniensis* and *A. Newberryi*, partaking of some morphological features of each. The pod is almost that of *A. Newberryi*, but the cavity is larger, and the ripe valves are not only of less rigid texture but simply hirsute and not both hirsute and tomentose. The prominently nerved stipules, which become glabrous dorsally and castaneous in age, are nearly matched in *A. musiniensis*, and the latter's occasional dolabriform hairs are also suggestive of a relationship to *A. loanus*, although here the laterally affixed hairs are more numerous and their basal arm is better developed. The flowers of the three species are essentially alike except that the petals of *A. loanus* (seldom observed) are whitish and not purple or purple-tinged throughout. A fourth related species is *A. eurekaensis*, which has a similarly hirsute but subligulate pod; however the vestiture is composed of strictly basifixed hairs. The known dispersal of the Loa milk-vetch is limited to an area of perhaps thirty miles diameter on the Sevier-Colorado watershed, the divide which serves to separate the vicariant ranges of *A. Newberryi* and *A. musiniensis*, and the question naturally arises as to whether *A.*

loanus arose as a hybrid between these related species. However that may be, the *Loa* milk-vetch is now a self-perpetuating species endowed with some characters found in neither of the possible parents.

The original concept of *A. Newberryi* var. *Wardianus*, upon which the name *A. loanus* technically rests, was a mixture of the genuine *Loa* milk-vetch as represented by the holotypus and forms of *A. Newberryi* with thinly pubescent pods. The dolabriform pubescence, overlooked in Ward's plant, was first noticed in a collection from *Loa Pass* in 1947 (*Ripley & Barneby*, cited above). The species has been collected otherwise only by Prof. Harrison at a point a few miles north of the Pass, and by Ward who made two gatherings on the same day in 1875, the type-collection and another, labeled "Price Creek Canyon near King's Meadows, 6400 ft." (US).

209. ASTRAGALUS NEWBERRYI

Dwarf or low, perennial but sometimes flowering the first season, the 1-several stems reduced to thick, obconic crowns crowded on the summit of a taproot and beset (after the first year) with a thatch of imbricated stipules and coarse, marcescent, recurving petioles, the herbage densely tomentulose with short, curly, and also (usually more abundantly, sometimes exclusively) silky-pilose or -strigose with longer, straight or nearly straight, rather stiff, lustrous hairs up to 1-2 mm. long, the longer hairs on the petioles and peduncles either loosely ascending or spreading, those of the leaflets either ascending or appressed (sometimes spreading late in the season), the inflorescence villous-pilose; *stipules* submembranous becoming scarious and ultimately brown and papery, ovate, lanceolate, ovate-or lance-acuminate, (3) 5-11 mm. long, semiamplexicaul; *leaves* (1.5) 3-13 (15) cm. long, with 3-13 (15) obovate, rhombic-elliptic, broadly oblanceolate, or rarely suborbicular, acute, obtuse, or sometimes retuse, flat, thick-textured, at length deciduous leaflets (3) 5-15 (20) mm. long; *peduncles* stout, (0.5) 1-10 cm. long, nearly always (usually much) shorter than the leaves, arcuate-procumbent in fruit; *racemes* loosely but shortly, often subumbellately (2) 3-8-flowered, the axis scarcely elongating, 0.3-2 (2.7) cm. long in fruit; *bracts* submembranous, greenish or purple-tinged, becoming pallid and papery, lanceolate or lance-acuminate, 3.5-10 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1.4-3 (4) mm., in fruit thickened, 2-3.5 (4.5) mm. long; *bracteoles* usually 0, rarely 2, exceptionally up to 4 mm. long; *calyx* (8) 9-20 mm. long, villous with loosely ascending (and often some shorter, curly) hairs up to 1 mm. long or more, the hairs of either sort being black, white, or of mixed colors, the subsymmetric or oblique disc 1-2 mm. deep, the membranous, pallid or purplish tube broadly to narrowly cylindric, or (in var. *Blyae*) deeply campanulate, the subulate or lance-subulate teeth (1.6) 1.9-6.5 mm. long; *petals* pink-purple with a pale lozenge in the fold of the banner, sometimes pale pink, or whitish tipped and margined with lilac or purplish-pink; *banner* recurved through $\pm 40^\circ$, broadly oblanceolate or rhombic-spatulate, shallowly or deeply notched, 14-32 mm. long; *wings* a little shorter, the narrowly lanceolate, obtuse or obliquely truncate blades nearly always gently incurved beyond the middle; *keel* 12-26 mm. long, the half-elliptic or lunately elliptic blades incurved through $40-85^\circ$ to the blunt apex; *anthers* 0.45-0.95 mm. long; *pod* ascending, or spreading and incurved, humistrate, seated on an obconic boss or incipient gynophore up to 1.2 mm. long, obliquely ovoid or ovoid-acuminate, (1.3) 1.8-2.8 cm. long, 7-11 (13) mm. in diameter, rounded, broadly cuneate, or subtruncate at base, obcompressed and openly depressed-sulcate ventrally (and sometimes also, but more often merely flattened, dorsally), tapering or abruptly contracted distally into a shortly triangular or deltoid-acuminate, $\pm$ incurved or backwardly hooked, laterally flattened beak, the somewhat fleshy valves becoming leathery, $\pm$ 0.2-0.4 mm. thick and reticulate when ripe, densely (rarely thinly) tomentulose with short, curly hairs and villous-hirsute with longer, lustrous, spirally twisted, straight or nearly straight, spreading

or widely ascending ones up to (2) 2.5–4.5 mm. long, the shorter hairs rarely sparse or almost wanting, the surface then visible between the longer villi; *septum* 0, but the dorsal suture sometimes a trifle thickened and raised within the cavity as a low ridge; *dehiscence* apical, through the gaping beak, after falling; *ovules* (20) 27–40 (46); *seeds* light or dark brown, sometimes almost black, smooth or punctate-rugulose but scarcely lustrous, 2.2–3.8 mm. long.

The Newberry milk-vetch is one of several intermountain astragali which bear pods so densely villous and tomentulose as to resemble bombycine cocoons or pellets of cotton. This is such a striking feature that it tends to overshadow the differences between the species. Except for the uncommon *A. eurekaensis*, already mentioned in the subsectional key, *A. Newberryi* is alone in having a pod of this sort combined with a vesture of stiff, shining hairs (not entangled and cottony) and all stems reduced to thickened crowns beset with persistent leaf-bases. The species is variable in stature, in number of leaflets, in size of the flowers, and in curvature of the pod, but only one poorly differentiated geographic race seems to be sufficiently well stabilized to deserve taxonomic status.

Key to the Varieties of *A. Newberryi*

1. Flowers large, the calyx (11.5) 13–20 mm., the banner 21.5–32 mm., the keel (18.4) 20–26 mm. long (if exceptionally smaller, the leaflets only 3–5); widespread 209a. var. *Newberryi*
1. Flowers smaller, the calyx (8) 9–11.5 mm., the banner 14–18 (22) mm., the keel 12–15 (18) mm. long; leaflets 9–13; n.-w. Arizona (Mohave County) 209b. var. *Blyae*

209a. *ASTRAGALUS NEWBERRYI* var. *NEWBERRYI*

Leaflets 3–13 (15); *calyx-tube* (8.8) 10.4–13.7 mm. long, 3.7–6.2 mm. in diameter, the teeth (1.9) 2.5–6.5 mm. long; *wings* (20) 21–29 mm. long, the claws (10.7) 12–14.5 mm., the blades (9.3) 11–16.3 mm. long; *keel-claws* (11.2) 12–14.7 mm., the blades (6.8) 8–11 (12.2) mm. long, 3–4 mm. wide; *anthers* (0.55) 0.6–0.85 (0.95) mm. long.—Collections: 129 (xxxi); representative: *Cronquist* 7189 (NY, RSA); *Ripley & Barneby* 6468 (IDS, NY, RSA); *Clokey* 7993 (NA, WS); *Maguire & Holmgren* 25,243 (NY, RSA, UTC, WS); *Train* 2721 (NY, TEX); *Jones* 5197, 6227 (POM); *Munz* 13,738 (POM); *Jones* (from Peach Springs, Arizona) in 1884 (GH, NY, POM); *Barneby* 12,655 (CAS, RSA); *Baker* 420 (GH, NMC, NY, POM).

Plains, foothills, canyons, gullied knolls, and badlands, in dry gravelly or sandy clay soils of varied composition and origin, in equal vigor and abundance on sedimentary and eruptive bedrock, (2000–3300) 4300–7800 feet, commonly in sagebrush or juniper-piñon forest, widespread and locally plentiful throughout Nevada (except the northwest corner) and southwestern Utah, extending northwest into southeastern (and to remote stations at the foot of the Cascades in east-central) Oregon, and southwest into the Death Valley region and eastern Mohave Desert in California; also, somewhat less commonly, east across northern Arizona from Grand Canyon, Peach Springs, and the Bill Williams and Verde Valleys into northwestern New Mexico, thence sporadically east across the Continental Divide into the upper Rio Grande Valley, south in Arizona to the Natanes Plateau in Gila County.—Map No. 84.—April to June.

ASTRAGALUS NEWBERRYI (Dr. John Strong Newberry, 1822–1892, geologist and naturalist with Lieut. Ives's Expedition, 1857–8) Gray in Proc. Amer. Acad. 12: 55. 1876.—“On the frontiers of Utah and Arizona, Newberry. Cañon east of Glenwood, Sevier County, Utah, at 7000 ft., Lester F. Ward on Powell's Expedition, 1875.”—Holotypus, collected by Newberry at Camp 74, n. borders of Arizona . . . lat. 36° 30', in 1858, GH! isotypi, NY, US (dated “April 16, 1858”)!—The paratypus, *Ward* 223 = *A. loanus* described above.—*Xylophacos Newberryi* (Gray) Rydb. in Bull. Torr. Club 32: 662. 1905. *A. Newberryi* var. *typicus* Barneby in Amer. Midl. Nat. 37: 477. 1947.

Astragalus eriocarpus (with hairy pod) Wats. in Bot. King 71. 1871 (non DC., 1802).—“Found on the foothills of the Trinity and of the East and West Humboldt Mountains, Nevada;

5–6000 feet altitude . . . No. 273.”—Holotypus, labeled “Coyote Mountains, Nevada,” Watson 237 in 1869, US! isotypus (dated “1868”), GH!—*Tragacantha Watsoniana* (Serenio Watson) O. Kze., Rev. Gen. 942. 1891, a legitimate substitute of epithet. *Astragalus suturalis* (presumably from the pod's prominent ventral suture) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a superfluous substitute. *A. Watsonianus* (O. Kze.) Sheld. in op. cit. 144. 1894. *A. Newberryi* var. *eriocarpus* (Wats.) Jones in Proc. Calif. Acad. Sci. II, 5: 676. 1895. *A. Newberryi* var. *Watsonianus* (O. Kze.) Jones, Contrib. West. Bot. 10: 68, Pl. 6. 1902.

Astragalus Newberryi var. *castoreus* (of beavers, from the Beaver Dam Mountains) Jones in Proc. Calif. Acad. Sci. II, 5: 658. 1895.—“No. 5006. April 4, 1894, Copper Mine, 18 miles west of St. George, Utah, in gravel, 5000° alt.”—Holotypus, Jones 5006, POM! isotypi, NY, US (2 sheets)!

Astragalus Purshii × *Newberryi* Jones, Rev. Astrag. 216. 1923.—“This grows on the Sevier.”—Lectotypus, Jones 5338e, collected at Marysville, Utah, 21 May, 1894, POM!

Astragalus Purshii × *Watsonianus* Jones, Rev. Astrag. 216. 1923.—“This grows in eastern Nevada.”—Lectotypus, Jones, collected at Aurum, Nevada, in May, 1893, POM! isotypus, NY!

The range of *A. Newberryi* extends over an immense crescentic area, of which the outer curve approximately follows the western and southern margins of the Great Basin and Colorado Plateau. The crescent is bisected in northern Arizona by the Colorado River, and there is some evidence that racial differentiation between the series of populations to the north and south of the Grand Canyon is now in progress. The eastern branch, as typified by the original Newberry collection, is a dwarf plant with few (mostly 3–9) leaflets silvery-silky with exclusively straight hairs, relatively short calyx-teeth (rarely exceeding 3 mm.), and flowers of moderate length (the banner rarely over 2.5 cm. long). Northward from southcentral Nevada the average plant of the Newberry milk-vetch is of more robust mien, with more numerous leaflets beset with shorter curly hairs underlying the longer straight ones, and with calyx-teeth and flower as a whole ordinarily longer. Furthermore the pod of this coarse phase (= *A. Watsonianus*) tends to be more prominently beaked, and the beak itself is often more strongly incurved or even backwardly hooked. In southern Utah and Nevada, however, one finds many insensibly intergrading colonies or even single plants which effectively combine the ideal differences attributed to *A. Newberryi* and *A. Watsonianus*, so that definition of two races becomes impossible in practice.

Three remarkable forms of *A. Newberryi*, all deserving further study and possibly taxonomic status, must be mentioned here. The first is from the north slope of the Kaibab Plateau in Coconino County, Arizona (Barneby 12,672, CAS, RSA). It combines with the growth-habit and few leaflets of precisely typical *A. Newberryi* an extraordinarily small flower, with calyx only 9–9.5 mm. and teeth $\pm$ 1.6 mm. long, the banner and keel only 16.5–17 mm. and $\pm$ 13.5 mm. respectively. The plants would key to var. *Blyae*, but the leaflets are only 3–5. More collections are needed. The second is remarkable for having all leaves uni- or trifoliate and densely silvery with closely appressed hairs. This ornamental form, of which I have seen no flowers, was collected at the extraordinarily low elevation of 2000 feet at the south end of the Aquarius Mountains, where Burro Creek crosses from Yavapai into Mohave County, Arizona (Benson & Darrow, 10,898, ARIZ. POM). The third was collected “on hard, dry alkaline flats, with *Enceliopsis* and *Distichlis stricta*, between Big Spring and Point of Rocks in Ash Meadows, southern Nye County, Nevada, at 2280 ft.” (J. C. & A. R. Roos 6143, NY), at elevations far below the known limit of the species in the region and in an unusual habitat and environment. Unlike typical *A. Newberryi*, which everywhere forms a small tuft composed of one up to about half a dozen crowns, the Ash Meadows plant has an elaborately forking caudex impacted with white clay and very numerous crowns gathered into a low cushion or (according to the collectors' field note) “dense round mats up to 4 dm. across.” The specimens were collected in mid-June, and their faded flowers are unsuited for accurate dissection; but so far as I can determine, they have all essential characters of *A. Newberryi*, although the leaflets are small (2–5.5 mm. long) and the racemes reduced to one or possibly sometimes two flowers. The material suggests an ecotype of *A. Newberryi* analogous to the cushion-forms of *Oxytropis oreophila* and *A. calycosus* found on valley knolls (often with *Enceliopsis*) in Nevada (cf. Barneby, 1952, p. 214). Fragments of this interesting plant were collected on Ash Meadows as early as 1898 by C. A. Purpus (No. 6034, POM).

209b. ASTRAGALUS NEWBERRYI var. BLYAE

Leaflets 9–13; calyx 8–11.5 mm. long, the deeply campanulate tube (5) 6–8.5 mm. long, 4–4.7 mm. in diameter, the teeth 2–3 mm. long; wings 13–18.6 mm. long, the claws 6.5–11.2 mm., the blades 7.5–9.4 mm. long, $\pm$ 2.3 mm. wide; keel-blades 5.7–7 mm. long, 2.2–2.8 mm. wide; anthers 0.45–0.65 mm. long.

Collections: 8 (ii); representative: *Mrs. Bly* (topotypi) in 1928 (G, GH, K, NY, PH); *Kearney & Peebles* 11,299 (CAS, NY), 13,123 (CAS, GH); *Ripley & Barneby* 3378 (CAS, RSA).

Dry rocky hillsides and canyons, on limestone or basaltic gravels, in a zone transitional between *Larrea* desert and desert grassland, 3500–4400 feet, locally plentiful in western Mohave County south of the Colorado River, northwestern Arizona.—Map No. 84.—Late March to May.

ASTRAGALUS NEWBERRYI var. *BLYAE* (Rydb.) Barneby in Amer. Midl. Nat. 37: 480. 1947, based on *Xylophacos Blyae* (Mrs. Charles Bly) Rydb. in N. Amer. Fl. 24: 303. 1929.—“Type collected at an altitude of 3500 feet on ridges one and one-half mile northwest of Kingman, Arizona, in 1927, *Mrs. Charles Bly* (U. S. Nat. Herb.).”—Holotypus, US! isotypus, NY!—*Astragalus Blyae* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.—Rydb., l.c., attributed the binomial *X. Blyae* to J. N. Rose who suggested the epithet, but hardly its generic status.

The Bly milk-vetch constitutes a minor modification of the widely dispersed *A. Newberryi* distinguished only by its small flowers and by its occurrence within or at the upper edge of the *Larrea* belt. Field experience has shown that it forms vigorous and uniform colonies and is therefore more than a depauperate state of *A. Newberryi*. It is further distinguished from the nomenclaturally typical phase of var. *Newberryi*, found on the Peach Springs Plateau immediately to the east and again in the Providence and New York Mountains across the Colorado River immediately to the west, in its slightly more numerous leaflets and, often, by its more nearly hirsute pubescence. The hairs on the calyx vary as in var. *Newberryi* from black to white, although black is predominant in the majority of specimens.

210. *ASTRAGALUS EUREKENSIS*

Low, tufted, strictly acaulescent, with a woody taproot and 1–several hard, turbinate crowns beset with a thatch of leaf-bases and scaly stipules, the leaves and peduncles pilose-pilosulous with rather stiff, straight or nearly straight, appressed and subappressed hairs up to (0.6) 0.8–1.4 mm. long, the herbage gray or silvery-canescenscent, the leaflets equally pubescent on both faces, the calyces (and sometimes the peduncles just below the flowers) hirsute with longer, spreading, white or commonly mixed black and white hairs up to (0.8) 1.2–2.5 mm. long; *stipules* closely imbricated, broadly lanceolate, 3–11 mm. long, at first pallid but rather firm, becoming papery, brownish, glabrescent, several-nerved; *leaves* (2) 4–15 cm. long, with stiff petioles and (3) 5–11 (17) narrowly elliptic, oblong-elliptic, rhombic-oblancheolate, or almost linear, acute or subacute, flat or loosely folded, readily deciduous leaflets 5–20 (25) mm. long; *peduncles* (1) 2.5–10 (14) cm. long, erect or incurved at anthesis, arcuate-recurved in fruit; *racemes* loosely but very shortly (1) 3–7-flowered, the flowers widely ascending, the axis little or not elongating, not over 1 cm. long in fruit; *bracts* lanceolate or linear-caudate, 4–8 mm. long, pallid but rather firm; *pedicels* ascending, straight or nearly so, at anthesis 1.2–2 mm., in fruit thickened, persistent, 1.5–3 mm. long; *bracteoles* 0; *calyx* 10.5–15.5 mm. long, the oblique disc 1.1–1.8 mm. deep, the cylindric (often a little constricted upward) tube (7) 8.5–10.5 mm. long, 3.7–4.5 mm. in diameter, the subulate or lance-subulate teeth 2.5–5.7 mm. long, the whole becoming membranous, ruptured, marcescent; *petals* commonly ochroleucous, more or less faintly veined or distally suffused with lurid purple, the keel-tip maculate, rarely purple throughout; *banner* recurved through $\pm 40^\circ$, oblanceolate or rhombic-oblancheolate, 22–26 mm. long, 7–10 mm. wide; *wings* 19–24 mm. long, the claws 10.5–12.5 mm., the narrowly lanceolate blades 8.5–13 mm. long, 2–2.4 mm. wide, slightly incurved at or beyond the middle; *keel* 18–22 mm. long, the claws 11–14 mm., the lunately oblanceolate blades 7.5–9.5 mm. long, 2.7–3.2 mm. wide, gently incurved through $70\text{--}90^\circ$ to the broadly rounded apex; *anthers* 0.55–0.7 mm. long; *pod* ascending (humistrate), readily deciduous, obliquely lance-ovoid, 1.5–3 (4) cm. long, (5) 6–9 mm. in diameter, obcompressed toward

the obtuse base, strongly incurved and contracted distally into a triangular- or deltoid-acuminate, firmly cuspidate beak, both the sutures prominent, the fleshy, green valves becoming brown, firmly leathery or subligneous, rugulose-reticulate, villous-hirsute with widely spreading, lustrous hairs up to 3 mm. long rarely mixed with shorter curly ones, the vesture not or scarcely concealing the surface of the valves, becoming tawny when dry; *dehiscence* apical, after falling; *ovules* 26–36; *seeds* not seen.—Collections: 18 (i); representative: *Jones 1690* (NY, POM); *Jones* (from Johnson's Pass) in 1890 (POM), and (from Cedar Fort) in 1896 (POM); *Tidestrom 2083* (NY); *Ripley & Barneby 4778* (CAS, RSA).

Gravelly clay benches and hillsides on limestone or sandstone, often in light shade of juniper or piñon, 4500–6500 feet, locally plentiful in scattered stations in the drier mountains around the east edge of the Great Basin in Utah, from the south shore of Great Salt Lake south around both sides of Utah Lake to the middle Sevier Valley and, apparently becoming rarer, to the east edge of the Escalante Desert in Iron County.—Map No. 84.—April to June.

ASTRAGALUS EUREKENSIS (of Eureka, Utah) Jones, Contrib. West. Bot. 8: 12. 1898 ("*Eurekensis*"), based on *A. glareosus* sensu Jones in Zöe 3: 291. 1892 (non Dougl.).—"... occurs sparingly throughout the Great Basin region of Utah..."—Lectotypus (Rydb. 1925, p. 234; Barneby, 1947, p. 482), collected at Eureka, Juab County, Utah, by M. E. Jones in 1891, POM! isotypus, GH! cotypi (fr.), collected by Jones the same year at Homansville, Juab County, GH, POM!—*Xylophacos eurekensis* (Jones) Rydb. Fl. Rocky Mts. 1063. 1917.

Astragalus Newberryi × *eurekensis* Jones, Rev. Astrag. 217. 1923.—"Lake Point Utah, No. 1743, May 29, 1880."—Holotypus (*Jones 1743*), POM! isotypi, NY (3 sheets), US!—*Xylophacos medius* (intermediate, supposedly, between *A. Newberryi* and *A. eurekensis*) Rydb. in Bull. Torr. Club 52: 232. 1925.

The Eureka milk-vetch is closely related to *A. Newberryi*, and although they are almost always easily recognized alive or dead by trivial or imponderable characters of vesture and coloring, substantial and constant differential criteria are lacking. Flowering plants of *A. eurekensis* are usually identified by the more closely appressed vesture of the petioles and scapes and the whitish (when dry stramineous) petals more or less suffused distally or also lined with lurid purple, combined with foliage of a dull leaden-gray. Its simply hirsute rather than hirsute and tomentose pod is ordinarily distinctive. However I have seen a few examples of scapes hirsute for at least a short distance below the flowers, and of a pod bearing some short curly hairs intermixed with the lustrous longer ones. The typus of *Xylophacos medius* had apparently purple (according to Jones only purple-tipped) flowers, suggestive of *A. Newberryi*, and is further remarkable for its few (mostly 5 or 7), rather large leaflets. There is evidence that whitish flowers characteristic of *A. eurekensis* can occur on plants with leaflets as large and few, and the purple coloring of *X. medius* is therefore reasonably interpreted as a minor individual variation. There is no particular reason to interpret *X. medius* as a hybrid involving *A. eurekensis* and *A. Newberryi*, especially since the second supposed parent has not been traced north nearly so far in Utah.

The history of *A. eurekensis* goes back to 1877, when Edward Palmer first discovered it near the southern limit of its range, at Paragonah, in Iron County. The collection was referred by Gray (in herb.) to *A. Newberryi*, a species of which the densely woolly pod was yet unknown. In the early nineties Jones began to find the species abundant in the mountains west and south of Salt Lake City, and identified it first with *A. Chamaeleuce*, later with the then misunderstood *A. glareosus*. The first description of *A. eurekensis* as an independent entity appeared under the latter name.

LVI (v). Subsectio COCCINEI

Growth-habit, vesture, and pod of subsect. *Newberryani*; flowers very large, the scarlet petals erect or nearly so, the banner and keel both $\pm$ 3.5–4 cm. long, the wings a little shorter; pod large, 2.5–4 cm. long, densely villous-tomentulose; *ovules* 34–43.—Sp. 1, xerophyte, of the transmontane deserts of southeastern California, extending just into extreme southwestern Arizona and extreme northern Baja California.

ASTRAGALUS sect. ARGOPHYLLI subsect. COCCINEI Jones, Rev. Astrag. 201, in clave. 1923.—

Sp. typica: *A. coccineus* Brand.—*Xylophacos* sect. *Coccinei* (Jones) Rydb. in Bull. Torr. Club 52: 144, in clave. 1925.

211. ASTRAGALUS COCCINEUS

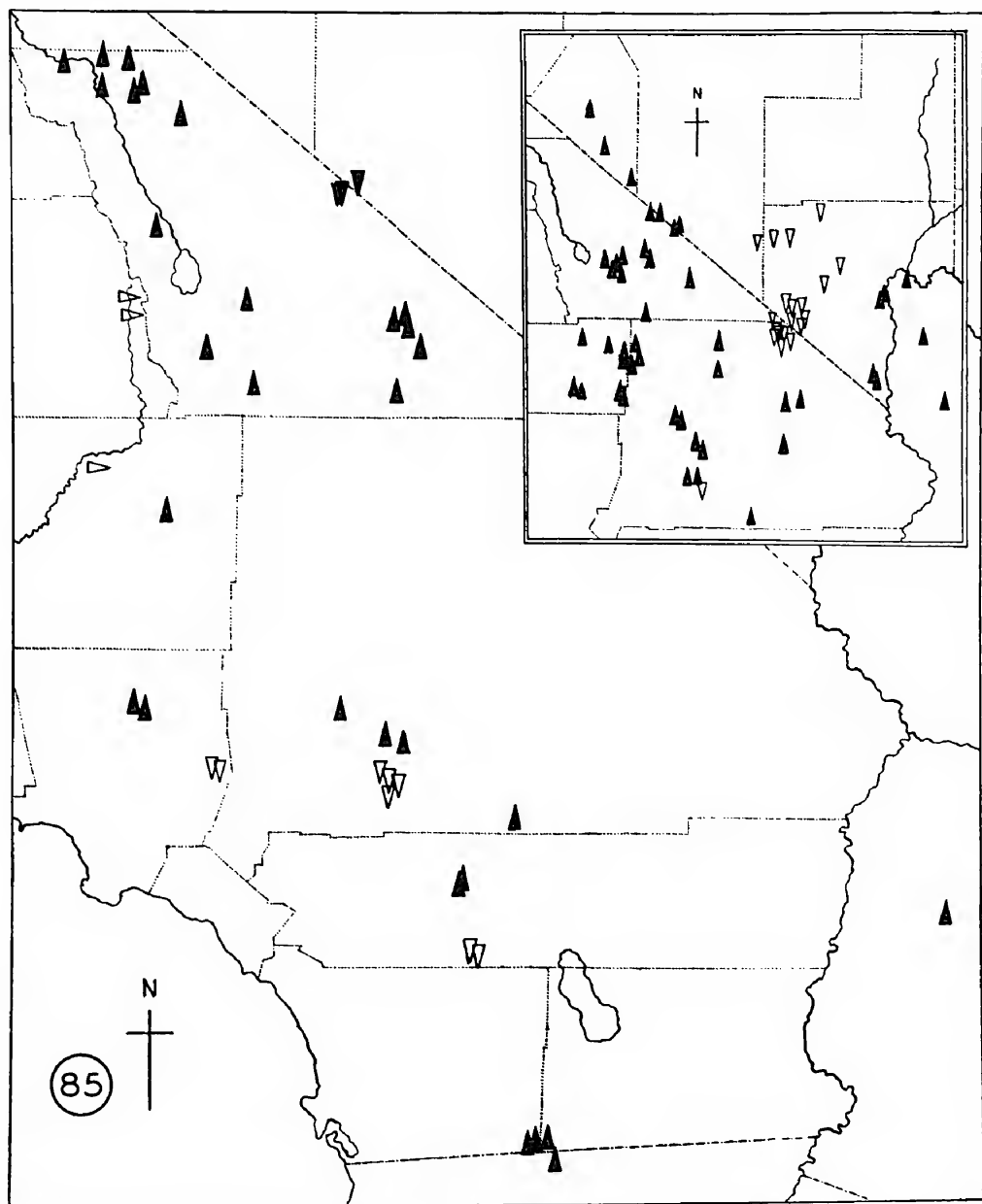
Low, tufted, obligately acaulescent, mature plants composed of 1—several crowns clustered on the head of a woody taproot and beset with a thatch of persistent stipules and stout (but not rigid) recurving petioles, densely villous-tomentose throughout with mixed shorter curly hairs and longer nearly straight, ascending or spreading ones up to 1.5–2.5 mm. long, the herbage at first white-silky, becoming tomentose late in the season; *stipules* papery-membranous beneath the vesture, lanceolate or deltoid-acuminate, 6–10 mm. long, $\pm$ semiamplexicaul; *leaves* radical, (3) 4–10 cm. long, with stout petiole and 7–15 obovate-cuneate to broadly oblanceolate and obtuse, or elliptic and subacute, thick-textured, flat or loosely folded leaflets (3) 5–14 mm. long; *peduncles* stout, (2) 4–10 cm. long, ascending at anthesis, procumbent in fruit; *racemes* shortly but loosely, sometimes subcapitately (3) 5–10-flowered, the flowers ascending at a narrow angle, the axis little elongating, 0.5–2.5 cm. long in fruit; *bracts* membranous, lance-acuminate, 5–7 mm. long; *pedicels* ascending, or a little arched outward in age, at anthesis 3–4 mm., in fruit thickened, 4–5 mm. long; *bracteoles* commonly 0, rarely a minute scale concealed by the vesture; *calyx* 18–24 mm. long, villous with white and often some black hairs, the subsymmetric disc 2–2.7 mm. deep, the membranous, reddish, cylindric tube (12) 13.5–16 mm. long, 4.6–6 mm. in diameter, the firm, subulate or lanceolate teeth 3.5–8 mm. long; *petals* scarlet, drying crimson, the fold of the banner whitish with red veins; *banner* recurved through 20–30°, broadly oblanceolate, either obtuse to very shallowly emarginate or broadly triangular-subulate at apex, 3.5–4.1 cm. long, 1.2–1.7 cm. wide; *wings* slightly shorter, 34.5–37.5 mm. long, the claws 1.7–2.1 cm., the linear-oblong or -lanceolate, obtuse or obliquely truncate, straight blades 1.8–2 cm. long, 2.8–3.8 mm. wide; *keel* $\pm$ equaling the banner and surpassing the wings, 3.5–4 cm. long, the claws 17.5–21 mm., the erect, subsymmetrically elliptic-oblanceolate, triangular-acute blades 1.9–2.1 cm. long, 5.2–6.6 mm. wide; *anthers* 1.2–1.5 mm. long; *pod* ascending (humistrate), obliquely lance-ovoid, narrowly ovoid-ellipsoid, or lunately ellipsoid, 2.5–4 cm. long, 9–12 mm. in diameter, rounded or broadly cuneate at base, obcompressed and either flattened or sulcate both ventrally and dorsally in the lower $\frac{1}{2}$, thence passing upward into an incurved, acuminate, laterally flattened beak, the moderately fleshy valves becoming leathery, faintly rugulose-reticulate, and $\pm$ 0.3 mm. thick when ripe, not inflexed, the surface of the valves concealed by the dense vesture of shorter curly together with longer, straighter, and spreading hairs up to 2–3 mm. long; *dehiscence* apical, through the gaping beak, after falling; *seeds* brown or dark purplish-brown, smooth or pitted, dull, 2.5–4.2 mm. long.—Collections: 42 (v); representative: *Duran* 545 (CAS, GH, NY, OB, POM, WIS); *Heller* 8190 (CAS, GH, NY, PH); *Munz & Johnston* 5221 (GH, POM); *H. B. Crandell* (from Kofa Mts., Arizona) in 1952 (ARIZ, CAS).

Open gravelly ridges and canyon benches of desert mountains, commonly on decomposed granite, with piñon, juniper, or sagebrush, 2100–7000 feet, sometimes carried down along washes into the *Larrea* belt as low as 150 feet, but hardly persistent there, widespread and locally plentiful in scattered stations around the north and west edges of the Mohave and Colorado Deserts, from Owens Valley and Death Valley south to the north slope of the San Gabriel, San Bernardino, and Little San Bernardino Mountains, and from the San Jacinto Mountains south into extreme northern Baja California; also disjunctly on the Kofa Mountains, Yuma County, Arizona. A report from the Charleston Mountains, southern Nevada,

was based on a specimen of *A. Newberryi* (Purpus in 1898, UC).— Map No. 85.
—March to early June.

ASTRAGALUS COCCINEUS (scarlet) Brand. in Zoë 2: 72. 1891.—“... near the summit of the Inyo Range by Mr. C. P. Rixford, and by myself at Lone Pine on the slopes of Mt. Whitney.” —Cotypi, *Brandegee* from Lone Pine and *Rixford*, since loc., neither dated, mounted together on one sheet, UC!—*Xylophacos coccineus* (Brand.) A. Hell., *Muhlenbergia* 2: 217. 1906.

Astragalus grandiflorus (large-flowered) Wats. in Proc. Amer. Acad. 17: 370. 1882—
“In San Bernardino Mountains, toward the Mohave Desert, at 5000 feet altitude, S. B. & W. F.



Map No. 85. Southern California and parts of adjacent states. Range of *A. coccineus*; of *A. leucolobus*; of *A. subvestitus*. Also, inset, the Mohave Desert. Range of *A. Tidestromii*; and of *A. Layneae*.

Parish, May, 1882."—Holotypus, *Parish Bros. 1280*, GH! isotypus, DS!—Non *A. grandiflorus* L., 1753.

Astragalus Purshii var. *coccineus* (scarlet) Parry ex Orcutt in W. Amer. Sci. 7: 10. 1890.—"sent by C. R. Orcutt . . . from the western borders of the Colorado Desert . . ."—Holotypus, collected by Orcutt at Mountain Springs, San Diego County, California, April 3, 1890, US! isotypi, GH, MO, NY!

No astragalus can surpass the splendid effect of *A. coccineus* flowering after a rainy spring, and few come close to rivaling it. The fiery blood-red of the long, narrow flowers is accentuated by the tufts of white or ashen foliage, and in the clear desert air assumes a brilliant transparency. Only two other American astragali have red flowers, the Mexican *A. Helleri* and *A. sanguineus*, both strongly caulescent plants with fully bilocular pods. Fruiting specimens are sometimes difficult to distinguish from *A. Newberryi*, for the habit of growth and especially the hard, thickened crowns beset with stiff, recurved bases of the leaf-stalks are almost identical. The pod, however, is ordinarily longer and consequently of a more slender, fusiform outline, and vestiges of the characteristic petals can often be found clinging with the papery-marcescent calyx about the base of the fruit. The pod of *A. coccineus* most closely resembles that of *A. funereus*, a rare Death Valley endemic which Jones referred to subsect. *Coccinei*; but this is at least potentially caulescent, and the foliage has the soft cottony-pannose vesture of subsect. *Eriocarpis*.

Although the scarlet coloring of the flower is most immediately striking and memorable, its form is of equal interest. The petals are irregularly graduated, the wings being shorter than the banner and keel, and all stand almost vertically erect out of the calyx, the banner being much less strongly recurved than in related *Argophylli*. The prominent, subsymmetrically elliptic, subacute blades of the keel are peculiar to the scarlet milk-vetch. The papilionaceous corolla has been modified so as to appear (superficially) tubular or tubular-infundibuliform, a type attractive to hummingbirds, whose partiality to the red segment of the spectrum is well known. Whether this is a case of cause and effect or merely a random modification is hard to say. I can only marvel at the abrupt acquisition of a spectacularly altered flower by a plant which has retained all other features of its closer kindred.

LVI (vi). Subsectio ERIOCARPI

Acaulescent, subacaulescent, or strongly caulescent, tufted, matted, or diffuse, the stems (when developed) and foliage cottony-tomentose or -tomentulose with extremely fine, twisted, $\pm$ entangled hairs; *stipules* free; *flowers* loosely, often subumbellately racemose, variable in size, the banner 9–31 mm. long; *petals* commonly pink-purple, sometimes whitish with maculate keel-tip; *pod* obliquely ovoid to lance- or oblong-ellipsoid, obcompressed proximally, contracted distally into a laterally compressed beak, very slightly to very strongly incurved, flattened or sulcate dorsally, the $\pm$ fleshy valves becoming leathery or stiffly papery, rarely subligneous, densely villous-tomentulose, simply hirsute, or simply tomentulose (often resembling a ball of cotton), uni- or (in southern California) partially to fully bilocular; *dehiscence* apical, through the beak, after falling; *ovules* 11–41 (46).—Spp. 7, xerophytes, widely dispersed in western United States and southern Canada (southern British Columbia and southern Alberta to western North and South Dakota, northern Colorado, central Utah, southern and cismontane California, and the Columbia Basin).

ASTRAGALUS sect. ARGOPHYLLI subsect. ERIOCARPI (Gray), stat. nov., based on *Astragalus* sect. *Eriocarpis* Gray in Proc. Amer. Acad. 6: 212. 1864.—Sp. lectotypica: *A. Purshii* Dougl.—*Astragalus* sect. *Lanocarpus* Sheld. in Minn. Bot. Stud. 1: 141. 1894, a superfluous substitute.

Xylophacos sect. *Glareosi* Rydb. in Bull. Torr. Club 52: 144, in clave. 1925.—Sp. typica: *X. glareosus* (Dougl.) Rydb. = *A. Purshii* var. *glareosus* (Dougl.) Barneby.

From the point of view of abundance of individuals and virtual ubiquity in the sagebrush and piñon belts, the *Eriocarpis* constitute one of the most important groups of *Astragalus* in western United States. Almost throughout the Great Basin they form a substantial element of the spring flora, although the plants are generally inconspicuous, because of their dwarf or diffuse habit of growth, except during a brief precocious period of bloom. The complex of races grouped below under *A. Purshii* form the nucleus of the subsection, the remaining species being in all probability recently derived under the pressure of particular geographic and edaphic circumstances.

The subsection is altogether similar in general organization to the genuine *Argophylli*, from which the species differ collectively in their usually copious vesture of extremely fine, curly, entangled hairs, soft and cottony or pannose-tomentose to the touch, and of characteristic texture and appearance under low magnification. The densely hirsute-tomentose pods so familiar in the commoner species, *A. Purshii* and *A. utahensis*, are neither a consistent nor an exclusive feature of the subsection, as the epithet *Eriocarpi* might suggest.

Key to the Species of Subsect. Eriocarpi

1. Pod (often very densely) both hirsute and tomentose, or simply hirsute, the longest hairs up to (1.2) 1.5–8 mm. long (and less than 1.5 mm. long only n. of the 40th parallel) (2)
2. Racemes 8–18-flowered; n.-e. Oregon and s.-e. Washington to w. Montana; *leaflets* of some upper leaves nearly always 8–11 pairs 218. *A. inflexus*
2. Racemes 2–11-flowered, but not over 8-flowered in the range of the preceding; *leaflets* mostly 3–8, rarely 10 pairs (3)
3. Pod simply and rather thinly villous-hirsute, the surface of the fleshy, at length stiffly leathery valves not concealed by the vesture; *flowers* large, the banner 20.5–25.5 mm. long; diffuse, caulescent plants of low elevations along the Snake River and its affluents in s.-w. Idaho and adjacent Oregon 217. *A. nudisiliquus*
3. Pod both hirsute and tomentose, the vesture nearly always so dense as to conceal the surface, and often the shape of the pod's valves (but if, exceptionally, thinner, then the plants shortly caulescent, or tufted, and the flowers smaller) (4)
4. Flowers large, the petals irregularly graduated, the prominent keel 2.4–2.7 cm. long, 0.5–2 mm. longer than the wings, the banner only a little longer, 2.4–3 cm. long; *pod* 3–5 cm. long; very local, Death Valley region, Inyo County, California 215. *A. funereus*
4. Flowers large or small, but the petals regularly graduated, the keel 11.5–22 mm. long, shorter than the wings; *banner* less than 2.4 cm. long in s.-e. California; *pod* not over 2.7 cm. long; widespread (5)
5. Body of the pod (stripped of the vesture) lance-ellipsoid or narrowly ovoid-acuminate, $\pm$ 3–4 times longer than wide, nearly straight, wholly concealed by the shaggy vesture of silky, cream-colored hairs as long or nearly as long as the pod's diameter; *leaflets* mostly obovate and obtuse; *petals* purple; centr. and n. Utah to centr. Nevada, extreme s.-e. Idaho, and s.-w. Wyoming 216. *A. utahensis*
5. Body of the pod obliquely ovoid, $\pm$ twice as long as wide, or if proportionately narrower then contracted into a stiff, incurved, deltoid beak; *vesture* of the pod much shorter than the pod's diameter, or thinner and not concealing the valves, the hairs commonly white; widespread over much of w. United States and s.-w. Canada, but extending only to the periphery of the range of the preceding, and there either the petals whitish, or the leaflets elliptic and acute to subacute, or both 212. *A. Purshii*
1. Pod (either thinly or densely) short-tomentose, the longest hairs either not, or scarcely, over 1 mm. long; local species of interior s. California (s. Sierra Nevada to Santa Rosa Mountains) (6)
6. *Leaflets* (7) 11–19; *raceme-axis* (0.5) 2–8 cm. long in fruit; *banner* 16–18.5 mm., keel 14.3–16.8 mm. long; *pod* (1.3) 1.5–2.5 cm. long, grooved dorsally, subbilocular; *ovules* 18–24; San Antonio, San Bernardino, and Santa Rosa Mountains 213. *A. leucolobus*
6. *Leaflets* 7–11 (13); *raceme-axis* 0.3–1.6 cm. long in fruit; *banner* 11–13.3 mm., keel 9.5–10.7 mm. long; *pod* 0.8–1.5 cm. long, dorsally flattened at base but scarcely sulcate, subunilocular, the septum rudimentary when present; *ovules* 11–14; s. Sierra Nevada and Piute Mountains, Tulare and Kern Counties 214. *A. subvestitus*

212. ASTRAGALUS PURSHII

Low, acaulescent, subacaulescent, loosely to densely tufted, sometimes pulvinate, or less commonly caulescent and diffuse, or loosely to densely matted, with a taproot and sometimes a well-developed, slenderly forking caudex, densely villous, villous-tomentose, or pannose, the vesture composed of fine, mostly sinuous

or twisted (and often some straighter, ascending or spreading) hairs up to (0.8) 1–2.3 (2.5) mm. long, the stems, when developed, white-tomentose, the herbage gray or white, the pubescence often somewhat silky in youth, becoming duller and cottony in age; *stems* 0–1 dm. long, some internodes occasionally up to 2 cm. long, but usually all shorter than the stipules; *stipules* membranous, pallid with green midrib, becoming scarious in age, ovate, lanceolate, or lance-acuminate, or rarely -caudate, (2.5) 3–15 mm. long, decurrent around $\pm \frac{1}{2}$ of the stem's circumference; *leaves* 1–12 (15) cm. long, all slender-petioled, with (3) 5–17 (21) crowded or moderately distant, flat or loosely folded leaflets varying from suborbicular and broadly obovate-cuneate and obtuse to narrowly elliptic and acute, 2–14 (20) mm. long; *peduncles* at anthesis ascending or erect, commonly shorter (rarely longer) than the leaves, sometimes almost 0, arcuate-procumbent or prostrate and radiating in fruit; *racemes* loosely but shortly, often subumbellately (1) 2–10 (11)-flowered, the flowers ascending at a narrow (rarely a wide) angle, the axis not or little elongating, up to 2 (4) cm. long in fruit, usually less; *bracts* membranous, lanceolate, lance- or ovate-acuminate, or -caudate, 2–9 mm. long; *pedicels* ascending, straight or a trifle arched outward, at anthesis 1–3.6 (4.5) mm., a little thickened and longer in fruit; *bracteoles* almost always 0, minute when present; *calyx* (5.5) 6–16 (18.7) mm. long, villous with white, mixed black and white, or all black hairs, the disc campanulate or turbinate, slightly to strongly oblique, the tube membranous, pallid or purplish, deeply campanulate to cylindric, the teeth subulate, lanceolate, or more rarely lance-caudate, or triangular, the orifice often oblique; *petals* whitish, ochroleucous, pale pink, or brilliant pink-purple, when pale the keel-tip maculate; *banner* gently recurved through $\pm 40^\circ$, broadly to narrowly oblanceolate, spatulate, rhombic-oblanceolate, or rarely obovate-flabellate, 9–25 (26.5) mm. long, shallowly to deeply notched; *wings* a little shorter, the blades lance-oblong, linear-oblong, or narrowly lance-elliptic, obtuse or rarely obliquely emarginate, straight or commonly a trifle incurved in the distal $\frac{1}{3}$ – $\frac{1}{2}$; *keel* again shorter, 8–21 (22.5) mm. long, the blades lunately elliptic to half-obovate, gently or quite abruptly incurved through 85 – 100° to the bluntly rounded apex; *anthers* 0.4–0.8 (1.05) mm. long; *pod* ascending (humistrate), sessile on a conical boss or well-defined gynophore up to 1.6 mm. long (its length correlated with the depth of the calycine disc), obliquely ovoid or broadly lance-ellipsoid, 7–27 (30) mm. long, (3) 3.5–11 (13) mm. in diameter, straight or nearly so and strongly or at least perceptibly dorsiventrally compressed in the lower $\frac{1}{2}$ – $\frac{2}{3}$, thence passing upward gradually or abruptly into the slightly to strongly incurved, shortly triangular to lance-triangular, laterally flattened, rigid beak, scarcely to quite deeply sulcate along either or both sutures, the fleshy valves becoming leathery, very densely villous- or hirsute-tomentose with sinuous, or largely almost straight, white or more rarely cream-colored hairs up to (1.2) 1.5–5 mm. long, the vesture nearly always concealing the brownish surface of the valves, these not at all inflexed, or in one var. inflexed as a nearly complete, rarely complete septum up to 1.4 mm. wide; *ovules* 14–38 (46); *seeds* ochraceous, greenish- or purplish-brown, sometimes purple-dotted, or almost black, smooth or variably pitted, dull, rarely wrinkled, 1.3–2.8 (3.4) mm. long.

The Pursh milk-vetch is the prototype of its group, a low, tufted or matted plant with softly gray-hairy foliage and proportionately long and narrow flowers giving rise to pods which resemble balls of cotton. The species is variable and polymorphic, composed of many geographic races. The following account follows the preliminary revision (Barneby, 1947, pp. 494–512) in most respects. Study of ever-increasing accumulations of new material and a more extensive field experience have modified my former concept of var. *tinctus*, especially as this occurs in the California Coast Range (var. *longilobus*) and Mohave Desert (var. *flocclatus*);

and the limits of the species have been very slightly widened to admit the too closely related *A. ophiogenes*. The reader interested in the history or supposed differential characters of segregates mentioned below only in the synonymy is referred to the cited revision.

Attempts to devise a practical key to the varieties of *A. Purshii* are never wholly successful. This situation is due partly to the inherent variability of the plants, partly to the circumstance that flowers, preferably fresh (or with annotation of their color when fresh) are generally required for identification. Flower-size of fruiting material can, however, often be inferred from measurement of the marcescent calyx, always allowing for a shrinkage of $\pm 10\%$ unless restored by soaking.

Key to the Varieties of *A. Purshii*

1. Flowers large, the calyx (tube and teeth together) (8) 9–16 (19) mm., the banner (14.6) 16–26 mm., the keel (11.5) 12.5–22.5 mm. long (2)
 2. Petals (except for the maculate keel-tip) whitish or ochroleucous, more rarely (in Nevada, passage to var. *tinctus*) the wings and banner tipped with dull, pale bluish-purple; widespread from Nevada and n.-e. California to interior Washington, s. Alberta, w. North Dakota, and n.-w. Colorado 212a. var. *Purshii*
 2. Petals purple or pink-purple throughout; British Columbia to s. California (both cis- and transmontane), s.-w. Montana, and s.-centr. Nevada (3)
 3. Flowers large, the keel over 15 mm. long (if of central Nevada the pod not strongly sulcate ventrally in the proximal half) (4)
 4. Leaflets mostly 7–9, broadly obovate or suborbicular and obtuse; acaulescent plants of e.-centr. Idaho and s.-w. Montana 212f. var. *concinus*
 4. Leaflets either elliptic and acute, or if broader (as in the preceding) more numerous and the plants shortly caulescent; range otherwise (5)
 5. Pod not, or only very shallowly and obscurely sulcate ventrally; *leaflets* mostly 7–13 (but frequently 13–17 s.-ward, outside the range of the next), commonly obtuse, if acute, then the flowers (3–11) mostly more numerous than in the next, or smaller, or both; w. Nevada, s.-e. Oregon, and cis- and transmontane California 212b. var. *tinctus*
 5. Pod deeply sulcate ventrally in the proximal half; *leaflets* always elliptic and acute or subacute, mostly 9–17 in number; *flowers* (2–5) consistently large, the banner 19–25 mm. long; Columbia Basin, lower Snake River Plains, extending s. just into n.-e. Nevada and n.-w. Utah 212c. var. *glareosus*
 3. Flowers somewhat smaller, the keel 11.5–15 mm. long (6)
 6. Pod strongly sulcate ventrally in the proximal half; local in centr. Nevada 212d. var. *pumilio*
 6. Pod not, or only shallowly and obscurely sulcate ventrally; n.-w. Nevada, n.-e. California, s.-e. Oregon, and s.-w. Idaho (7)
 7. Pod small, 8–13 mm. long, abruptly and strongly incurved at or above the middle through 90–180°; *raceme-axis* relatively long, (0.6) 1–3 (4) cm. long; local along the Owyhee, Snake, and lower Bruneau Rivers in s.-e. Oregon and s.-w. Idaho 212e. var. *ophiogenes*
 7. Pod mostly longer; *racemes* subcapitately flowered; cf. small-flowered variants of var. *tinctus* in n.-e. California, n.-w. Nevada, and e. Oregon
 1. Flowers small, the calyx (5.5) 6–9 mm., the banner 9–15 mm., the keel 8–11.7 mm. long (8)
 8. Racemes 1–5 (7)-flowered; *leaflets* (3) 5–9 (11); California, and along the foothills and plains adjacent to the e. slope of the Cascades in Oregon (9)
 9. Pod incurved only in the beak; *ovules* 24–32; Sierra Nevada and San Bernardino Mountains, California 212g. var. *lectulus*
 9. Pod arched throughout, at least through a $\frac{1}{2}$ circle, often further; *ovules* 14–20; plains of n.-e. California and w. transmontane Oregon 212h. var. *lagopinus*
 8. Racemes (3) 5–11-flowered; *leaflets* (7) 9–15 (17); local in s.-w. Idaho and adjoining Oregon 212e. var. *ophiogenes*

212a. *ASTRAGALUS PURSHII* var. *PURSHII*

Stems 0–10 cm. long; *leaves* (1.5) 3–10 (15) cm. long, with (5) 7–15 (17) nearly always elliptic, elliptic-oblongate, or rhombic-elliptic and acute, rarely obovate and obtuse leaflets (2) 4–14 (20) mm. long; *racemes* (1) 2–5 (6)-flowered; *calyx* (12) 13–16 (19) mm. long, the tube 9.2–12 (13.6) mm. long, 2.9–5.1 mm. in diameter, the teeth 2.2–6 (7) mm. long; *banner* 19–25 (26) mm. long, 7.6–12 (13) mm. wide; *wings* 17.3–22.5 mm. long, the claws 10–13.5

(14.2) mm., the blades (7.5) 8–12.6 mm. long, 2.7–3.6 mm. wide; *keel* (15) 17–21.2 mm. long, the claws (9.9) 11–13.8 mm., the blades (6.3) 6.6–8.8 (9.4) mm. long, 2.7–3.6 mm. wide; *pod* obliquely ovoid or broadly lance-ellipsoid, 1.3–2.3 (2.7) cm. long, 5–9.5 (13) mm. in diameter, not or very shallowly sulcate ventrally, the surface of the valves nearly always concealed by the dense shaggy vesture of hairs up to (2) 2.5–4 (5) mm. long; *ovules* (20) 22–34; *seeds* 1.9–2.7 (3.4) mm. long.—Collections: 151 (xix); representative: *Piper* 2288 (GH, NY, POM, WS, WTU); *Jones* 3830 (CAS, NY, POM); *Watson* 274 (GH, NY); *Ripley & Barneby* 8722 (CAS, RSA, UTC); *A. & E. Nelson* 5699 (GH, ND, NY, POM); *Ripley & Barneby* 5428 (CAS, GH, RSA).

Dry hills and plains, characteristic of the sagebrush deserts of the northern and western Great Basin, but also on barren, gravelly slopes in piñon-juniper woodland, on sandy flats and banks in yellow pine forest, on river terraces, and gullied bluffs or knolls, without apparent rock preference, ranging from 1250 feet along the Columbia River up to 7600 feet in northern Colorado, widespread and locally abundant from southcentral Nevada through transmontane Oregon to eastern Washington, east through the Rocky Mountains to the plains of southern Alberta and southwestern Saskatchewan, southwestern North Dakota, and western South Dakota, south to the head of the North Platte, Grand, and Yampa Rivers in northwestern Colorado, and to the Uinta Basin in northeastern Utah.—Map No. 86.—April to June, rarely July, flowering in earliest spring.

ASTRAGALUS PURSHII (Frederick Pursh, 1774–1820) Dougl. ex Hook., Fl. Bor.-Amer. 1: 152. 1831.—“On the low hills of the Spokan River, North-West America. *Douglas*.”—Holotypus, “... on the barren grounds...,” K! isotypi, BM (dated 1827), OXF (“N.-W. America”)!—*Tragacantha Purshii* (Dougl.) O. Kze., Rev. Gen. 947. 1891 (“*Purschii*”). *Phaca Purshii* (Dougl.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 369. 1906. *Xylophacos Purshii* (Dougl.) Rydb. in Bull. Torr. Club 32: 662. 1905. *Astragalus Purshii* var. *typicus* Barneby in Amer. Midl. Nat. 37: 496. 1947.

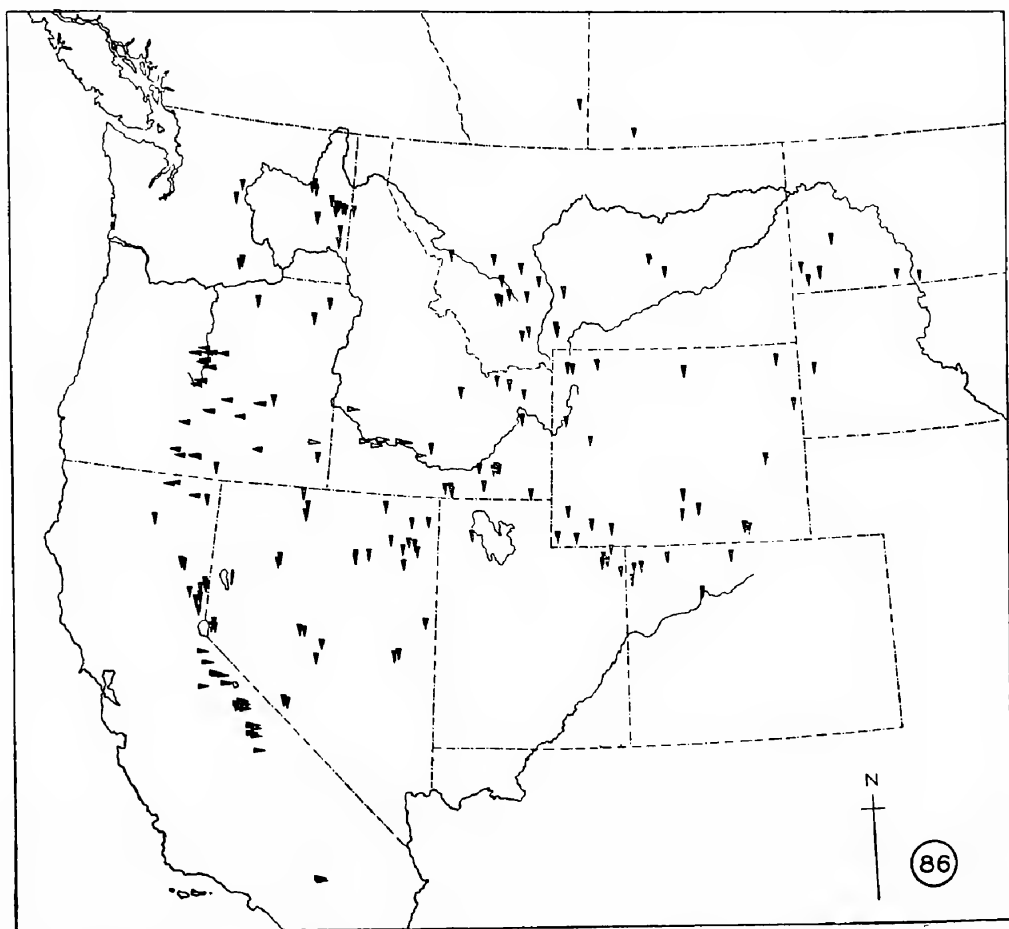
Phaca mollissima (very soft) Nutt. ex T. & G., Fl. N. Amer. 1: 350. 1838.—“Plains of the Rocky Mountains, and on the hills of ‘Ham’s Fork’ of the Colorado of the West.”—Holotypus, labeled by Nuttall “*Phaca *mollissima*. R. Mts.,” BM! isotypi, GH, NY! probable isotypus, mislabeled by Nuttall “*Astragalus argophyllus*,” the determination corrected by Gray, PH!—Non *A. mollissimus* Torr. (1827).

Astragalus Purshii var. *interior* (farther inland, though by original definition no farther so than typical *A. Purshii*) Jones, Rev. Astrag. 222, Pl. 55. 1923.—“... low humidity regions of the Great Plateau... from North Park Colorado to... Utah... Nevada and westward to the Sierras...” —Lectotypus (Barneby, 1947, p. 499), collected at Aurum, Nevada, May 4, 1893, *M. E. Jones*, POM! isotypi, CAS, GH, NY!

Xylophacos incurvus (incurved, of the pod) Rydb. in Bull. Torr. Club 52: 366. 1925.—“Type collected in California, in 1875, *Lemmon* 76...” —Holotypus, probably from Sierra Valley, Sierra or Plumas County, NY!—*A. Purshii* var. *incurvus* (Rydb.) Jeps., Fl. Calif. 2: 360. 1936. *A. incurvus* (Rydb.) Abrams, Ill. Fl. Pac. St. 2: 577, fig. 2803. 1944 (non Desf., 1800).

The typical form of the Pursh milk-vetch is distinguished simply by its whitish or cream-colored flowers, differing from var. *tinctus* by no other consistent character. Over an immense tract of prairie country, extending from the Missouri Valley in North Dakota west into the Rocky Mountains of Montana, Wyoming, and Colorado, and again over a considerable area in northeastern Nevada, var. *Purshii* is the only representative of its species. In western Nevada it passes insensibly into var. *tinctus*, and here are plants, sometimes singly and sometimes in colonies, in which the ochroleucous banner and wings are variably tinged or margined with lilac or dingy purple. In the Columbia Basin var. *Purshii* is relatively uncommon, at least much less prevalent than var. *glareosus*, which differs, like var. *tinctus*, in its bright purple flower, but also in its ventrally sulcate fruit. The var. *Purshii* is polymorphic, but such variable features as the length of the pod’s vesture, color of the calyx-hairs, and degree of caulescence are not geographically correlated. Two of the more remarkable forms deserve mention as minor variants:

M. v. 1. Stems well developed, forming loosely woven mats rather than the usual caespitose tufts, the plants superficially resembling *A. inflexus*. Occasional in the Great Basin, especially



Map No. 86. Parts of western North America. Range of *A. Purshii* (in part): $\blacktriangle$ var. *Purshii*; $\circ$ var. *ophiogenes*; $\blacklozenge$ var. *lectulus*; and $\blacksquare$ var. *lagopinus*.

in low ground. The typus of *A. Purshii*, as described by Hooker, was partly of this form, which has since been collected on several occasions in Spokane County where, however, it does not replace the typical form. Cf. Piper 2288 (GH, NY, POM, WS, WTU).

M. v. 2. Stipules, bracts, and calyx-teeth all elongate; pod strongly incurved. A local race, of yellow pine forest on the east slope of the Sierra Nevada in Lassen, Plumas, Sierra, and Nevada Counties, California. The differential characters are not consistently present in this area and occur occasionally, either separately or together, well outside it (*Xylophacos incurvus*). Cf. Ripley & Barneby 4528 (CAS, GH, RSA).

212b. *ASTRAGALUS PURSHII* var. *TINCTUS*

Habit of var. *Purshii*, not consistently distinguishable except by the purple petals, but with a different range of variation in several features; *stems* commonly a little developed, up to 9 (12) cm. long, the internodes up to 2 cm. long, usually less, the plants either loosely tufted or matted; *leaves* 2–8 (11) cm. long, with (3) 5–13 (17), or especially southward 11–17 broadly obovate-cuneate or oblanceolate and obtuse, more rarely elliptic-oblanceolate and acute or subacute leaflets 2–12 (14) mm. long; *racemes* 3–11-flowered; *calyx* (8) 10–14.2 (15.8) mm. long, the tube 6.5–11.8 mm. long, 2.9–4.8 mm. in diameter, the teeth (1) 1.4–3.5 (4.8) mm. long; *banner* (14.6) 15.4–25 mm. long, 6–12 mm. wide; *wings* (13.7) 14.8–24 mm. long, the claws 7.7–12.6 (13.4) mm., the blades (6.8)

7.8–11 (12.2) mm. long, 2.8–3.5 mm. wide; *keel* (11.5) 12.4–20.8 mm. long, the claws 7.7–12.6 (13.4) mm., the blades (4.3) 5–8.2 (9) mm. long, 2.3–3.5 mm. wide; *pod* as in var. *Purshii*, but the valves (especially in the Mohave Desert) sometimes inflexed as a partial or almost complete septum up to 1.4 mm. wide; *ovules* (18) 20–38 (46).—Collections: 144 (xii); representative: *Peck 25,061* (CAS, RSA), *25,112*, *25,121* (RSA); *Eastwood & Howell 9858* (CAS, RSA); *Greene 713* (ND, PH); *Barneby 11,515* (CAS, NY, RSA); *Purpus 5879* (POM); *Ripley & Barneby 4466* (CAS, RSA).

Dry gravelly or sandy hillsides, plains and mesas, nearly always among sagebrush, most commonly on basaltic or granitic bedrock, 3750–8000 (9500) feet and descending along the Klamath River into pine forest as low as 1500 feet, widespread and locally common along the east base of the Sierra Nevada from northern Inyo County, California, north through western Nevada to Lake, Harney, Deschutes, and Wheeler Counties, Oregon; west in northern California from near Truckee Pass to the foothills of Mt. Shasta, the Klamath Basin, and south in the inner North Coast Range to Anthony Peak, Mendocino County; also in scattered stations through the higher ranges of the northern and western Mohave Desert, from the Death Valley region to the Granite, Ord, and east slope of the Tehachapi Mountains, thence west and northwest through the southern Sierra Nevada (Greenhorn Range; Baker Ridge) to Mt. Piños and the inner South Coast Range in San Benito County; apparently isolated on the Wallowa Mountains, northeastern Oregon.—Map No. 87.—April to June (July), rarely again in fall.

ASTRAGALUS PURSHII var. *TINCTUS* (dyed, of the purple flowers) Jones in *Zoë* 4: 269. 1893.—“Edgewood near Mt. Shasta and also in Ventura County, Cal., Brandegee; Olancho and Keeler, Inyo County, Cal., Brandegee; the former also by Miss Eastwood, Soda Spring, Nevada County, Cal., 1882, Jones . . .”—Lectotypus (Barneby, 1947, p. 502), collected at Soda Springs, Nevada County, California, *Jones in 1881*, POM!—The paratypes represent various minor variants mentioned below.—*Phaca Purshii* var. *tincta* (Jones) Piper in *Contrib. U. S. Nat. Herb.* 11 (Fl. Wash.): 369. 1906.

Astragalus Purshii var. *longilobus* (with long calyx-teeth) Jones in *Zoë* 4: 269. 1893.—“Tehachapi, June, 1884, Brandegee; Aurum, Nevada, May 4, 1893, Jones (not in fruit) . . .”—No specimen so labeled found at CAS, POM, UC, the only spm. at UC so annotated by Jones, *Brandegee* from Reno, Nevada = var. *Purshii*. Lectotypus, collected at Tehachapi, without date or number, *K. Brandegee* (UC, 2 sheets); Jones’s collection from Aurum likewise = var. *Purshii*.

Astragalus consectus (cut up, the application obscure) Sheld. in *Minn. Bot. Stud.* 1: 143. 1894.—“Collected in California, 1846, Fremont; Carson Valley, Utah, 1859, Engelmann; Utah, 1874, C. C. Parry; and at Tejon Pass, southern California, June, 1887, S. B. Parish . . . The last specimen . . . may be taken as the type.”—Holotypus, *Parish 1890*, MINN! isotypus, NY!—The paratypes include elements of *A. utahensis* and *A. Newberryi*.—*Xylophacos consectus* (Sheld.) Rydb. in *Bull. Torr. Club* 40: 49. 1913. *A. leucolobus* subsp. *consectus* (Sheld.) Abrams, Ill. *Fl. Pac. St.* 2: 578, fig. 2809. 1944.

Astragalus candelarius (of Candelaria) Sheld. in *Minn. Bot. Stud.* 1: 142. 1894.—“ . . . near Candelaria, Esmeralda [now Mineral] County, Nevada, April and May, 1888, by W. H. Shockley.”—Holotypus, *Shockley 33*, MINN! isotypi, ND, NY, US!—*Xylophacos candelarius* (Sheld.) Rydb. in *Bull. Torr. Club* 52: 370. 1925.

Astragalus candelarius var. *exiguus* (slight and small) Sheld. in *Minn. Bot. Stud.* 1: 143. 1894.—“ . . . beside the road to Sierra Valley, Nevada county, California, May, 1886, by C. F. Sonne; also near Candelaria, Esmeralda county, Nevada, by W. H. Shockley.”—Cotypi, *Sonne 66*, collected 23 May, 1886, and *Shockley 33 in part*, collected in May, 1886. MINN!

Astragalus inflexus var. *flocclatus* (beset with flocs of wool) Jeps., *Man. Calif.* 573, fig. 564. 1925.—“Panamint Mts., Hanaupah Cañon, *Jepson 6999*, type.”—Holotypus, collected May 9, 1917, JEPS!

Astragalus inflexus var. *ordensis* (of Ord Mountain) Jeps., *Man. Calif.* 573. 1925.—“Ord Mt., Mohave Desert (*Jepson 5877*, type).”—Holotypus, collected May 3, 1914, JEPS!—*A. Purshii* var. *ordensis* (Jeps.) Jeps., *Fl. Calif.* 2: 360. 1936.

Xylophacos subvillosus (somewhat villous, less so than *A. utahensis*) Rydb. in Bull. Torr. Club 52: 368. 1925.—“... in Sierra Valley, California, in 1873; Lemmon (herb. N. Y. Bot. Gard.).”—Holotypus, NY! isotypus, GH!

Astragalus Purshii var. *gavisus* (delighted, meaning delightful) Jeps., Fl. Calif. 2: 360. 1936.—“Scott River Valley, Siskiyou Co., T. H. Gilbert (type).”—Holotypus, collected June 15–July 15, 1899, UC!

The concept and circumscription of var. *tinctus*, as defined in these pages, are substantially more inclusive than those adopted in the preliminary revision (Barneby, 1947, p. 500, sequ.), and the range of the variety is greatly expanded in consequence. It now embraces the relatively small-flowered populations of northeastern California formerly referred to var. *lectulus*, as well as var. *longilobus*, the Pursh milk-vetch of the Mohave Desert and South Coast Range, and the formerly obscure var. *gavisus*. Material acquired during the past decade has demonstrated complete intergradation in flower-size between the so-called var. *lectulus* of the North Coast Range in Mendocino and Siskiyou Counties, California, and the lowland, mostly larger-flowered typical var. *tinctus* prevalent in the Klamath Basin. Furthermore, small-flowered plants, although usually less compact in growth-habit than those from the crest of the Coast Range, are known to occur with some frequency on the sagebrush plains of Modoc County and of adjoining Oregon and Nevada. It seems more natural to associate these sympatric forms under one name than to abstract the small-flowered extreme and attach this arbitrarily to the otherwise more southern and montane var. *lectulus*. Deprived of these northern elements, var. *lectulus* can be redefined as endemic to the Sierra Nevada and San Bernardino Mountains. The disadvantage of this rearrangement is a continuous series of flower-sizes from the smallest in var. *lectulus* to the largest in var. *tinctus*; almost nothing remains to distinguish two varieties except that in the northern populations, which most nearly approach genuine var. *lectulus* in length of the petals, the calyx-teeth are longer than in the Sierran plant. There can be no doubt that var. *lectulus* has been derived from var. *tinctus*, but it has achieved a more compact and better-defined range than the incipiently small-flowered, parallel development in the North Coast Range. It is interesting to find that a second small-flowered form simulating var. *lectulus* but with slightly larger flowers (keel $\pm$ 11 mm. long) has developed in isolation high in the Wallowa Mountains (Ice Lake, Peck 18,485; Aneroid Lake, Peck 17,976, both WILLU) in northeastern Oregon.

Little can be added to what was said (Barneby, 1947, p. 508) concerning variation in var. *longilobus*, herein reduced to var. *tinctus*. The length of the peduncles and number of leaflets, formerly thought to be good differential characters, have not proved to be very constantly associated within a natural area of dispersal. Typical var. *tinctus* in southwestern Nevada passes insensibly into the desert form (var. *flocculatus* and var. *ordensis*), and this in turn, in the Tehachapi Mountains, passes into the matted state (*A. consectus*) prevalent in the South Coast Range from Mt. Piños northward.

The typus of var. *gavisus*, tentatively referred in my revision to var. *lectulus*, has turned out to be a large-flowered form (calyx $\pm$ 14 mm., keel almost 17 mm. long) with obovate-cuneate leaflets. It represents an ecotype of var. *tinctus* found along the Scott and adjoining Klamath Rivers at elevations (low for the species) of about 1500–1800 feet and distinguished by a loosely matted, caulescent habit of growth.

The diverse climates and environments tolerated by var. *tinctus* doubtless favor the process of differentiation into geographic races. The more notable trends, readily perceived but not at present usefully definable in taxonomic terms, may be described as minor variants:

M. v. 1. Leaflets mostly 5–13, either acute or obtuse; flower large, the banner over 18 mm. long; peduncles shorter than the leaves (var. *tinctus*, sens. str.)—Nevada and northeastern California.

M. v. 2. Similar, but the foliage very densely pannose-tomentose; calyx-teeth unusually short, triangular.—Typically developed in sinter gravel about hot springs in southern Washoe County, Nevada, but forms transitional to typical var. *tinctus* are common in the region. Specimens of this variant were identified by Jones (in Zoë 4: 270) and by Rydberg (in Bull. Torr. Club 52: 366) as *A. utahensis*, but have the characteristic pod of *A. Purshii*.

M. v. 3. Similar to var. *tinctus*, sens. str., but flower smaller (banner 14.5–18 mm. long).—Klamath Basin, California, and adjoining Nevada and Oregon, mostly at middle elevations but reappearing on the crest of the North Coast Range from the Marble Mountains south to Mendocino Pass.

M. v. 4. Apparently the same as the montane phase of the last, but isolated on the Wallowa Mountains, northeastern Oregon.—Little known and to be studied further.

M. v. 5. Acaulescent or nearly so, densely long-villous; leaflets mostly 11–17; peduncles commonly equalling or surpassing the leaves; flowers of var. *tinctus*; pod often, but not invariably, semibilocular toward the base, the septum 0.5–1.4 mm. wide.—Mohave Desert, Inyo,

northern San Bernardino and eastern Kern Counties, California (var. *ordensis* and var. *floculatus* Jeps.).

M. v. 6. Commonly caulescent, loosely matted, the stems up to 14 cm. long; *leaflets* mostly 11–17; *peduncles* usually shorter than the leaves; *petals* commonly, but not invariably, little graduated, the flower closely resembling that of the related and vicariant *A. leucolobus* but the pod unilocular and long-hirsute.—Inner South Coast Ranges, California, San Benito County south to the head of San Joaquin Valley (*A. consectus* Sheld.).

212c. ASTRAGALUS PURSHII var. GLAREOSUS

Habit and vesture of var. *Purshii* or var. *tinctus*, either subacaulescent or shortly caulescent, the stems up to 5 cm. long; *leaves* (2) 3–12 cm. long, with (7) 9–17 (21) nearly always narrowly elliptic and acute or short-acuminate, rarely oval-oblongolate leaflets (2) 4–14 (17) mm. long; *racemes* 2–5 (7)-flowered; *calyx* 12–16 (18.7) mm. long, the tube (8.5) 9.5–12 (13) mm. long, 3.6–4.8 (5) mm. in diameter, the linear-lanceolate or subulate teeth 2.3–4.8 mm. long; *petals* purple, sometimes pale; *banner* 19–25 (26.5) mm. long, 7–10.5 (12) mm. wide; *wings* 19–24.5 mm. long, the claws 10–14.8 mm., the blades 8.8–11.3 (13) mm. long, (1.7) 2–3 mm. wide; *keel* 16.7–21 (22.5) mm. long, the claws 9.4–13.5 (14.5) mm., the blades 6.4–8.4 (10) mm. long, 2.3–3.5 mm. wide; *pod* obliquely ovoid, ovoid-ellipsoid, or lance-ellipsoid, lunately incurved or sometimes abruptly hooked, (1.3) 1.5–2.6 (3) cm. long, 7–11 mm. in diameter, strongly depressed-sulcate in the lower $\frac{1}{2}$, the sutures contiguous or approximate within, the valves villous-hirsute with hairs up to (1.2) 1.5–4 mm. long; *ovules* (17) 22–30 (35); *seeds* (1.8) 2–3.7 mm. long.—Collections: 131 (xi); representative: J. W. Thompson 11,499 (CAS, GH, NY, POM, RSA, WS, WTU); Cronquist 5648 (ID, RSA, SMU, WS), 7040 (NY, RSA); Ownbey & Ward 3108 (ID, RSA, SMU, TEX, WS); Maguire & Holmgren 26,278, 26,302 (NY, RSA, UTC).

Dry sandy and gravelly plains, foothills, bluffs, and canyon benches, nearly always among sagebrush, but ascending into openings in yellow pine forest, commonly on basaltic bedrock but also on granites and various alluvia, 200–5000 (6650) feet, widespread and locally abundant in the Columbia Basin, from southern British Columbia, where apparently localized in the Kamloops area and along the Okanogan River, through transmontane Washington to northern Oregon, south and southeast through the Blue Mountains and up the Snake River canyon into southeastern Oregon, southern Idaho, and rarely into extreme northwestern Utah and northeastern Nevada.—Map No. 87.—April to June, exceptionally again in fall.

ASTRAGALUS PURSHII var. GLAREOSUS (Dougl.) Barneby in Amer. Midl. Nat. 37: 503. 1947, based on *A. glareosus* (of gravelly places) Dougl. ex Hook., Fl. Bor.-Amer. 1: 152. 1831.—“Plentiful on dry gravelly banks of rivers, from the confluence of Lewis and Clarke’s River with the Columbia to the mountains. Douglas.”—Holotypus, from “the barren, sandy grounds,” K! isotypi (“N.-W. America”), GH (fragm.), P!—*Tragacantha glareosa* (Dougl.) O. Kze., Rev. Gen. 945. 1891. *Astragalus inflexus* var. *glareosus* (Dougl.) Jones, Contrib. West. Bot. 10: 62, Pl. 5. 1902. *Phaca glareosa* (Dougl.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 369. 1906. *Xylophacos glareosus* (Dougl.) Rydb., Fl. Rocky Mts. 1063. 1917.

Astragalus allanaris (white-woolly) Sheld. in Minn. Bot. Stud. 1: 141. 1894.—“... Rattlesnake mountain, Yakima County, Washington, June, 1884, also near Walula, Walla County, Washington, April, 1891, by Mr. W. H. Suksdorf.”—Lectotypus, Suksdorf 1811 from Rattlesnake Mountain, MINN! isotypus, WS! paratypus, Suksdorf 2004, MINN!

Astragalus lanocarpus (with woolly pod, the fruit likened to the oak-galls of *Andricus lanæ*) Sheld. in Minn. Bot. Stud. 1: 144. 1894.—“Klickitat Prairie, Washington, June, 1880, by Thomas J. Howell; also at Reno, Nevada.”—Lectotypus, Howell, MINN! isotypus, NY! the paratypus from Reno = var. *tinctus*, MINN!—*A. leucocystis* (with white bladder) Greene in Erythea 3: 76. 1895, a superfluous substitute.

Astragalus Booneanus (Rev. William Judson Boone, 1860–1936, founder and president of

College of Idaho, Caldwell) A. Nels. in Bot. Gaz. 53: 224. 1912.—“The species rests upon several very representative collections as follows: President W. J. Boone . . . at Caldwell, no. 2, . . . C. N. Woods, . . . Hailey, nos. 5 and 25a; Merrill and Wilcox, Leckie, Wyo., no. 583; and J. Francis Macbride, Falk's Store, Idaho, no. 57.”—Lectotypus, *Boone 2*, collected in May, 1910, RM!—The paratypes (RM) are conspecific with the exception of *Merrill & Wilcox 583*, which = *A. argophyllus* var. *Martini*.

(?) *Xylophacos ventosus* (windy, the type from “windy, rocky places”) Rydb. in Bull. Torr. Club 52: 370. 1925.—“ . . . several kilos east of Bingen [Washington], Nov. 10, 1920, *Suksdorf 10662*.”—Holotypus, NY! isotypus, WS!

The gravel milk-vetch, *A. Purshii* var. *glareosus*, is the common representative of its species at low elevations in the Columbia Basin, whence it extends in a southeasterly direction through the Blue Mountain system and reappears in abundance in the foothills enclosing the Snake River Plains. Its principal features are the narrow, acute leaflets, large and few, ordinarily bright purple flowers, and ventrally grooved legume. The pod's compression, stressed in the key as the principal differential character separating var. *glareosus* from the more southern var. *tinctus* (as well as, in the fruiting condition, from the sympatric but white-flowered var. *Purshii*), needs observation in the field by local botanists. The flowering season of the Pursh milk-vetch is early and short, whereas the pod matures over a period of several weeks, and it is uncommon to find fresh flowers and ripe fruits simultaneously in a colony. As a result, there is too little correlation between the form of the pod and the color of the petals. The outlying records of var. *glareosus* from Nevada, Utah, and southeastern Idaho are based on mature fruiting specimens, and proof that these populations are purple-flowered is still to be obtained. Conversely, a number of fruiting plants from the Columbia Basin have been identified as var. *Purshii* because the pod lacked a ventral groove, but these plants are in other respects closely similar to sympatric var. *glareosus* known to have purple petals. The dispersal of the two varieties needs accurate local mapping.

The typus of *Xylophacos ventosus* was collected in November and is, perhaps, not characteristic of its sort. It was interpreted (Barneby, 1947, p. 500) as representing an outlying population of var. *tinctus*, but this has not been traced farther north than the headwaters of the Deschutes River, at points a hundred miles south of the Columbia Gap. Other material from low elevations along the Columbia is too scanty to provide a clear picture of *X. ventosus*; it is suspected that it belongs with var. *glareosus* rather than var. *tinctus*.

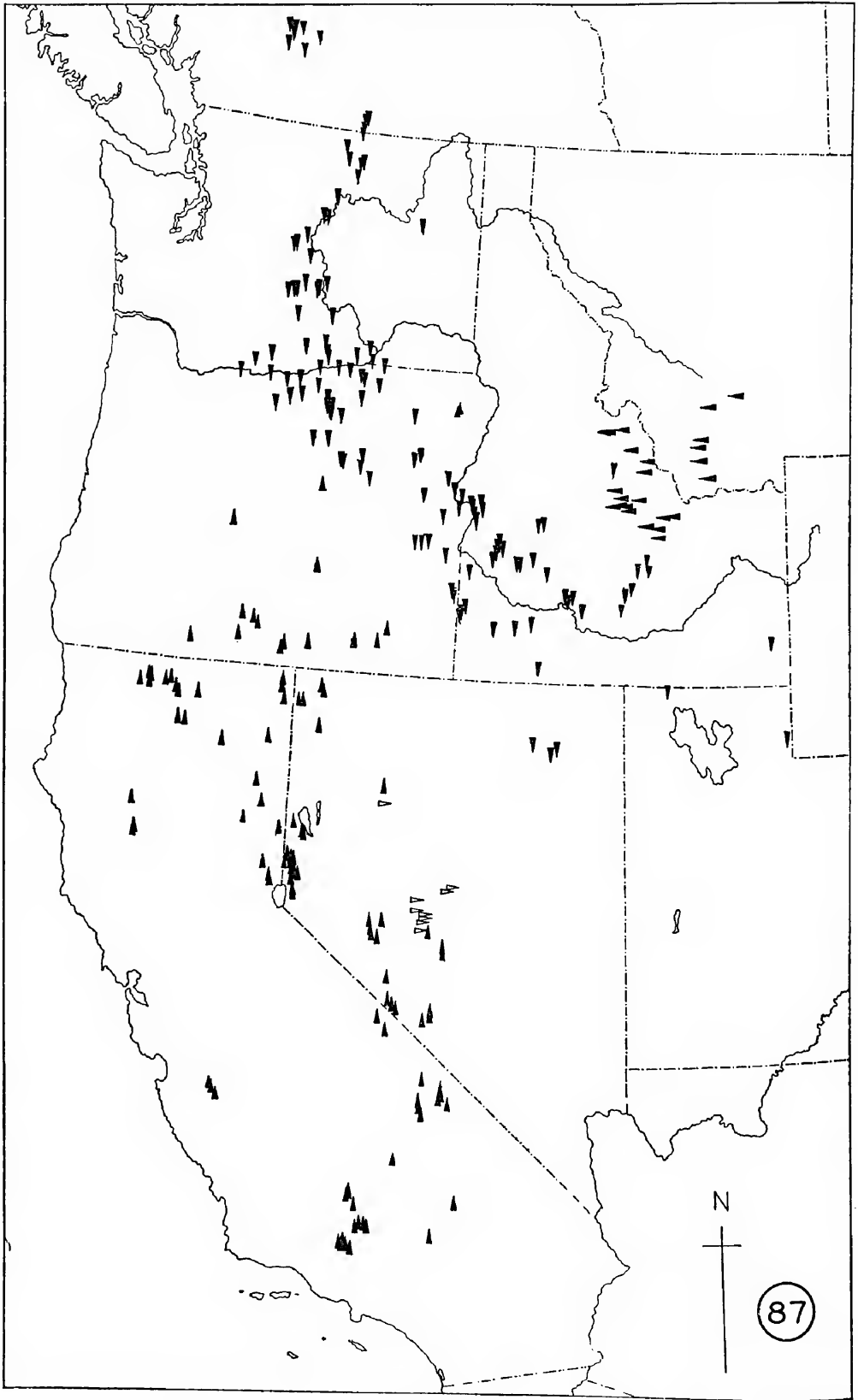
In eastern Oregon, especially along the upper Malheur River, a form of var. *glareosus* occurs in which the pod is only shortly and relatively thinly villous, the longest hairs only up to ± 1.2 mm. long. In the extreme state the vesture of the fruit is hardly denser than that found in the more loosely hirsute states of *A. argophyllus* var. *Martini*, from which, however, the cottony leaf-pubescent readily distinguishes it. Plants intermediate between this extreme and typical var. *glareosus* are common in the region (cf. *Ripley & Barneby 6110, 6117, RSA*).

Occasional specimens of the gravel milk-vetch, especially a shortly caulescent phase found along the upper reaches of the Grand Canyon of the Snake River, superficially resemble and have been confused with *A. inflexus*. The following contrasts may forestall confusion in the future:

1. Stems 0-5 cm. long; leaves all petioled, with (7) 9-17 (21) leaflets; racemes 2-5 (7)-flowered, the axis 0.5-2 cm. long in fruit _____ *A. Purshii* var. *glareosus*
1. Stems (5) 10-35 (50) cm. long; upper leaves subsessile, with (9) 17-23 (27) leaflets; racemes (5) 8-18-flowered, the axis (1.5) 2.5-6 (8) cm. long in fruit _____ *A. inflexus*

212d. ASTRAGALUS PURSHII var. PUMILIO

Dwarf, acaulescent or nearly so; leaves 2-5.5 (7) cm. long, with (7) 9-15 (17) oval or elliptic, obtuse or acute leaflets 3-8 mm. long; racemes loosely (2) 3-6-flowered, the axis 4-17 mm. long in fruit; calyx 8.6-12.6 mm. long, the cylindric or cylindro-campanulate tube 6.5-9 mm. long, 2.9-3.8 mm. in diameter, the teeth 2.1-4 mm. long; petals pink-purple; banner 16-18 (20.5) mm. long, 6.6-9 mm. wide; wings 15.3-18 (19) mm. long, the claws 7.3-8.7 (10.8) mm., the blades 7.7-9.5 mm. long, 1.8-2.7 mm. wide; keel (12) 13-15 (15.3) mm. long, the claws 7.4-8.6 mm., the blades 5.3-6.5 mm. long, 2.2-2.9 mm. wide; pod obliquely ovoid-acuminate, 8-15 mm. long, 3.5-7.5 mm. in diameter, nearly straight and deeply grooved ventrally in the lower $\frac{1}{2}$, thence abruptly incurved through 90° or more into the deltoid or lance-triangular beak, the valves shaggy-villous with hairs up to 1.6-2.2 mm. long; ovules 17-21; seeds 1.6-2.5



mm. long.—Collections: 11 (iii); representative: *Maguire & Holmgren 25,414, 25,419* (NY, RSA, UTC); *J. & M. Linsdale 883, 952* (CAS, RSA); *Jones in 1882* (POM, TEX).

Dry gravelly flats and hillsides, with piñon and sagebrush, 5500–6800 feet, locally plentiful in the foothills and on the lower slopes of the Desatoya, Shoshone, and Toiyabe Ranges, northwestern Nye and adjoining Churchill and Lander Counties, and of the West Humboldt Mountains, Pershing County, Nevada.—Map No. 87.—May and June.

ASTRAGALUS PURSHII var. PUMILIO (dwarf) Barneby in Amer. Midl. Nat. 37: 506. 1947. —“Foothills of the Toiyabe Range, south of Grass Valley, *Ripley & Barneby No. 5908*.”—Holotypus, collected May 22, 1944, CAS! isotypus, RSA!

The present variety was described from a meager sample but has become much better known in recent years. In the Toiyabe Mountains the Pursh milk-vetch is represented also by populations of var. *Purshii* and var. *tinctus*, but these have larger flowers than var. *pumilio* and larger pods not or scarcely sulcate ventrally. The pod of var. *pumilio* resembles that of var. *glareosus* reduced in size, and fruits are required to separate it from the smaller-flowered phases of var. *tinctus*.

212e. ASTRAGALUS PURSHII var. OPHIOGENES

Low, sometimes diminutive, subcaulescent or shortly caulescent, the stems 0–5 (8) cm. long; *leaves* 1.5–11 cm. long, with (7) 9–15 (17) elliptic-oblongate or obovate-cuneate, acute, obtuse, or rarely truncate-emarginate leaflets 4–12 mm. long; *racemes* (3) 5–11-flowered, the axis (9.6) 1–3 (4) cm. long in fruit; *calyx* 6.5–10.1 mm. long, the shortly cylindric tube 5.5–7.5 mm. long, 2.6–3.3 mm. in diameter, the teeth 1–2.6 mm. long; *petals* pink-purple, drying violet; *banner* 11.5–16.3 mm. long, 6.5–8.7 mm. wide; *wings* 11.4–14.6 mm. long, the claws 5.8–7.8 mm., the blades 6.4–7.6 mm. long, 1.9–2.6 mm. wide; *keel* 10.2–13 mm. long, the claws 5.8–7.7 mm., the blades 5.1–5.8 mm. long, 2.3–2.6 mm. wide; *pod* very obliquely ovoid-acuminate, 8–13 mm. long, 5–7 mm. in diameter, rounded or subcordate at base, strongly obcompressed and openly depressed-sulcate along both or at least along the ventral suture in the proximal $\frac{1}{3}$ – $\frac{1}{2}$, thence abruptly incurved through 90–180° into the laterally compressed, triangular-acuminate, cuspidate beak, the valves densely tomentose and villous-hirsute with shorter curly and longer straighter, lustrous hairs up to 3–5 mm. long, but the short, tomentose vestiture sometimes sparse or almost wanting; *ovules* $\pm$ 22; *seeds* 2.1–2.5 mm. long.—Collections: 11 (ii); representative: *J. & C. Christ 17,309* (ID, NY, RSA); *Maguire & Holmgren 26,266* (NY, RSA, TEX, UTC); *Jones 25,408, 25,435* (POM); *Ripley & Barneby 9403* (RSA).

Gravelly clay and sandy river terraces, gullied bluffs, dunes, and sandy pockets in lava flows, 2500–3500 feet, local and apparently rare, along the lower Bruneau and adjacent Snake Rivers in Gooding, Elmore, Owyhee, and Canyon Counties, Idaho, and on the Owyhee River in Malheur County, Oregon.—Map No. 86.—Late April to June.

ASTRAGALUS PURSHII var. OPHIOGENES (Barneby) Barneby ap. Hitchc. & al. in Univ. Wash. Pub. Biol. 17: 256. 1961, based on *A. ophiogenes* (snake-begotten, first found on the banks of Snake River) Barneby in Leaflet West. Bot. 4: 232. 1946.—“IDAHO: east of King Hill, Elmore Co., alt. 2500 ft., 31 May, 1945, *Ripley & Barneby No. 6478*.”—Holotypus, CAS! isotypi, GH, IDS, NY!

The present variety resembles var. *pumilio* of central Nevada in its small, strongly incurved pod, but it differs in the somewhat smaller, more numerous and more loosely racemose flowers. The much larger-flowered var. *glareosus* is common around the western periphery of

Map No. 87. Parts of western North America. Range of *A. Purshii* (in part): ♣ var. *tinctus*; ▼ var. *glareosus*; ♦ var. *concinus*; and ♂ var. *pumilio*.

the Snake River Plains but it is found in less specialized habitats than var. *ophiogenes*. Another species of the subsection, *A. nudisiliquus*, is sympatric with var. *ophiogenes* and like it is confined to bluffs and terraces along the banks of the Snake and tributary streams; this, however, is a much coarser, strongly caulescent plant, again with much larger flowers and a larger pod of fleshy, ultimately woody texture. Granted knowledge of their origin, one should have no practical difficulty in identifying even young flowering specimens of var. *ophiogenes*.

The var. *ophiogenes* was collected first by Dr. Edward Palmer (No. 63, WIS) in 1893 on the Snake River Plains at a place called the "Blue Lakes." I have not identified the locality.

212f. *ASTRAGALUS PURSHII* var. *CONCINNUS*

Dwarf, tufted, acaulescent or nearly so, the herbage densely pannose (as in *A. utahensis*); leaves 1.5–7 cm. long, with (5) 7–9 (11) obovate, obovate-cuneate, or broadly oval, more rarely some broadly elliptic, obtuse or truncate leaflets 3–12 (15) mm. long; racemes (2) 3–8-flowered; calyx 9–13 (14) mm. long, the deeply campanulate to broadly cylindric, commonly tumid tube 7.8–10.8 mm. long, (3.6) 4–5.5 mm. in diameter, the teeth 1.8–3 (4) mm. long; petals pink-purple; banner rhombic- or flabellate-obovate, on the average broader than that of var. *tinctus* or var. *glareosus*, (19) 20–24 mm. long, (11.4) 12–15 mm. wide; wings 18–20.5 mm. long, the claws 9.8–10.9 mm., the blades 9.7–11.8 mm. long, 2.8–3.4 mm. wide; keel 15.6–17.6 mm. long, the claws 9.9–10.9 mm., the blades (6) 6.9–7.6 mm. long, 2.8–3.6 mm. wide; pod as in var. *Purshii*; ovules 28–38.—Collections: 28 (iv); representative: *Macbride & Payson 1764* (CAS, GH, NY); *C. L. Hitchcock 15,673, 15,693, 15,732* (RSA, WS); *E. & L. Payson 1090* (GH, NY); *Ripley & Barneby 8120* (CAS, RSA).

Gravelly hillsides and valley flats, nearly always among sagebrush, commonly on limestone, mostly 4300–7000 feet but ascending on Mt. Borah up to 9000 feet, locally plentiful on and near the Lost-Salmon River divide in eastcentral Idaho, extending east across the Bitterroots to the Beaverhead and upper Jefferson Rivers in southwestern Montana.—Map No. 87.—May to July.

ASTRAGALUS PURSHII var. *CONCINNUS* (neatly beautiful) Barneby in Leaf. West. Bot. 4: 231. 1946.—"IDAHO: Challis, Custer Co., *Macbride & Payson No. 3224* . . ."—Holotypus, collected in 1916, NY! isotypi, CAS, GH, POM!

The broad, blunt, softly white-tomentose leaflets of var. *concinus*, the somewhat baggy, purplish calyx and the ample banner all suggest a condensed phase of *A. utahensis*; but the fewer (mostly 5–9) leaflets readily distinguish flowering plants, and the pod is that of *A. Purshii*, of which it is the only purple-flowered representative in its compact area of dispersal. The var. *glareosus* approaches the range of var. *concinus* in the Sawtooth foothills and in the neighborhood of the sink of Big Lost River, but differs in its more numerous, narrow, commonly subacute leaflets and by its ventrally furrowed pod. On account of its dwarf stature, white foliage, and proportionately large and generously proportioned flower, var. *concinus* is one of the most decorative of the *Argophylli*.

212g. *ASTRAGALUS PURSHII* var. *LECTULUS*

Subacaulescent, forming small tufts or closely woven mats, similar at all points to var. *tinctus* except for the small size of all parts; leaves (1) 1.5–5 cm. long, with (3) 5–9 (11) obovate-cuneate or oblanceolate and obtuse, sometimes elliptic and subacute, often crowded leaflets 2–10 mm. long; racemes 1–3 (5)-flowered, often embedded in the leaves; calyx (5.6) 6.1–8.8 mm. long, the tube 4.5–7.2 mm. long, 2.2–3 mm. in diameter, the teeth 1.1–1.6 mm. long; petals pink or pale purple; banner 10.3–15 mm. long, 5.4–7 mm. wide; wings 10.2–13.6 mm. long, the claws 5.6–7.1 mm., the blades 5.4–7.8 mm. long, 1.6–2.3 mm. wide; keel 9.4–11.7 mm. long, the claws 5.8–7.2 mm., the blades 4–5.1 mm. long, 1.9–2.5 mm. wide; pod exactly that of var. *Purshii* or var. *tinctus* but smaller, 7.5–15 mm. long, 4–8 mm. in diameter, shaggy-villous with hairs up to 1.5–3.5 mm. long; ovules 24–32; seeds 1.4–2 mm. long.—Collections: 37 (iii); representa-

tive: *Eastwood & Howell 8418* (CAS, GH); *Heller 8318* (CAS, GH, PH); *J. T. Howell 19,772* (CAS, RSA); *Munz 5687* (POM); *Parish 2997* (NY).

Dry open flats and benches in piñon-juniper or yellow pine forest, ascending on stony slopes and scree to crests above timber line, commonly on decomposed granites, 6000–11,000 feet, frequent and locally plentiful along the east slope and crest of the Sierra Nevada from Alpine south to Inyo County, California; west slope of the Sierra in Tuolumne County (± 7800 feet); locally abundant about the east end of the San Bernardino Mountains, San Bernardino County.—Map No. 86.—May to August.

ASTRAGALUS PURSHII var. *LECTULUS* (Wats.) Jones, Contrib. West. Bot. 10: 61, Pl. 6. 1902, based on *A. lectulus* (a little bed, from the softly matted foliage) Wats. in Proc. Amer. Acad. 22: 471. 1887.—“Common in sandy soil in Bear Valley, San Bernardino Mountains, at 6000 feet altitude (*C. C. Parry*, 1876; *S. B. Parish*, June, 1886); in the Sierra Nevada, near Sonora Pass, at 10,000 feet altitude (*W. H. Brewer*, July, 1863).”—Lectotypus, *Parry in 1876*, GH! paratypi, *Brewer 1906*, GH! *Parish in 1886* (some numbered 1812), GH, ND, NY!—*Xylophacos lectulus* (Wats.) Rydb. in Bull. Torr. Club 52: 371. 1925.

Xylophacos argentinus (silvery) Rydb. in Bull. Torr. Club 52: 371. 1925.—“Type collected at Lone Pine, California, May 14, 1897, *Jones*...”—Holotypus, GH! isotypus, US!—*A. Jonesii* (Marcus Eugene Jones, 1852–1934) Abrams, Ill. Fl. Pac. St. 2: 578, fig. 2810. 1944, a legitimate substitute; non *A. argentinus* (of Argentina) Manganaro, 1919.

The Sierran variety of the Pursh milk-vetch, var. *lectulus*, is defined more narrowly here than in the preliminary revision (Barneby, 1947, p. 509), a point already stressed in discussion of var. *tinctus*. The plants vary in stature from diminutive mats or small cushions, with flowers embedded in the crowded leaves, into looser and larger tufts simulating var. *tinctus* in habit of growth; the variation is apparently correlated with microhabitat and not simply with elevation. The dwarfest phase, characteristic of populations found along the Sierra crest, descends in arid gravelly places to the low limit of tolerance at about 6000 feet in the foothills, and it recurs in the San Bernardino Mountains on exposed gravelly knolls in Bear Valley and around Baldwin Lake. A looser phase, of which *X. argentinus* provides an extreme example, is a relatively uncommon plant of the foothills in Inyo and Mono Counties at 6000–7000 feet; it is found either in shelter of sagebrush or in relatively rich and moist soils.

The flowers of var. *lectulus* vary from pink-purple to pale flesh-pink. In the latter case the petals tend to turn yellowish on drying but are never ochroleucous (as described for *X. argentinus* or *A. Jonesii* by Rydberg and Abrams) in the fresh state.

212h. *ASTRAGALUS PURSHII* var. *LAGOPINUS*

At least shortly caulescent, the stems of the year up to 8 cm. long, arising in young plants from the root-crown, in older ones from a freely branching caudex, forming densely to quite loosely woven mats, 0.8–3 (3.5) dm. in diameter; leaves 1–4.5 (7) cm. long, with (3) 5–7 (11) narrowly to broadly obovate-cuneate, obtuse, truncate, or shallowly emarginate, rarely elliptic and subacute leaflets 5–12 (15) mm. long; racemes (2) 3–5 (7)-flowered; calyx (5.5) 6–9 mm. long, the short-cylindric or deeply campanulate tube (4) 4.5–6.7 mm. long, 2.2–3.1 mm. in diameter, the teeth (1) 1.4–3 mm. long; petals pink-purple, sometimes pale and merely tipped or margined with pink; banner 9–13.2 mm. long, (4) 5–6.6 mm. wide; wings either a trifle shorter or a trifle longer, 9–12.4 mm. long, the claws 4.3–6.5 mm., the blades (obtuse or rarely emarginate) 5.4–7 mm. long, 1.6–2.4 mm. wide; keel 8–11.3 mm. long, the claws 4.4–6 (6.8) mm., the blades 3.8–5 (5.9) mm. long, 1.8–2.5 mm. wide; pod ovoid or lance-ellipsoid, 7–17 mm. long, 3.8–5 (7) mm. in diameter, strongly incurved through at least half and up to a whole circle (this 6–10, rarely 13 mm. in diameter), openly and shallowly sulcate dorsally in the lower $\frac{1}{2}$, densely shaggy-villous with hairs up to 1.8–2.8 mm. long; ovules 14–20; seeds 1.3–1.7 mm. long.—Collections: 30 (ii); representative: *Cusick 2824* (GH, MINN, NY, POM); *Ripley & Barneby 6652* (CAS, NY, RSA); *Peck 21,932* (CAS, RSA), 25,407

(RSA, WILLU); *Eggleston 6838* (GH, NY); *Eastwood & Howell 8245* (CAS, US).

Dry plains and mesas, commonly in pumice sand among sagebrush, occasionally in dry rushy meadows about lake shores, 2900–4200 feet, locally plentiful along the east foot of the Cascade Range and over the adjoining plains, from the upper Deschutes River in Deschutes and Crook Counties, Oregon, south to the Lava Beds region in Modoc County, California; east sporadically in Oregon to Silver Creek and the Blitzen River in Harney County.—Map No. 86.—May to July.

ASTRAGALUS PURSHII var. *LAGOPINUS* (Rydb.) Barneby in Amer. Midl. Nat. 37: 511. 1947, based on *Xylophacos lagopinus* (like a hare's foot, in reference to the softly pubescent foliage and pod) Rydb. in Bull. Torr. Club 52: 372. 1925.—"Type collected on plains between Preneville [properly Prineville] and Bear Buttes, Crook County, Oregon, June 25, 1894, *Leiberg 326*."—Holotypus, NY! isotypi, MINN, POM, US!—*Astragalus lagopinus* (Rydb.) Peck, Man. Pl. Ore. 445. 1941 & in Madroño 6: 134. 1941.

Astragalus viarius (of the wayside) Eastw. in Leaf. West. Bot. 1: 178. 1935.—"Type... collected by John Thomas Howell, No. 7171, July 3, 1931, along the road 7 miles north of Bend, Deschutes Co., Oregon."—Holotypus, CAS!

The hare's-foot milk-vetch, var. *lagopinus*, is closely related to var. *lectulus*, and the two are not easily told apart until the fruit has formed. The average plant of var. *lagopinus* forms a wider mat of foliage, and the leaflets are more often obovate-cuneate and obtuse; but the strongly incurved or coiled pod and slightly lower ovule-number are the only reliable differential characters. Within its area of dispersal, var. *lagopinus* is distinguished from sympatric varieties of *A. Purshii* by the small size of both flower and fruit.

213. *ASTRAGALUS LEUCOLOBUS*

Closely resembling some forms of *A. Purshii* var. *tinctus*, subcaulescent or shortly caulescent, with a shortly forking caudex, canescently villous-villosulous throughout with extremely fine, sinuous, entangled, and often some (or many) longer, straighter, spreading hairs up to 0.6–1.3 mm. long; *stems* up to 7 cm. long, the internodes often shorter than the stipules, or 1–5 of them developed, up to 2 cm. long but mostly shorter; *stipules* submembranous, pallid, becoming papery-scarious, broadly deltoid-ovate to lance-acuminate, 2–10 mm. long; *leaves* (1.5) 2.5–9 cm. long, all petioled, with (7) 11–19 elliptic to broadly obovate, obtuse, acute, or shortly acuminate, flat or loosely folded, often crowded leaflets 3–13 mm. long; *peduncles* incurved-ascending at anthesis, prostrate in fruit, (3) 5–13 cm. long, the more vigorous ones (or commonly all) equaling and surpassing the leaves; *racemes* loosely but shortly 5–13-flowered, the axis $\pm$ elongating, (0.5) 2–8 cm. long in fruit; *bracts* submembranous, broadly lanceolate, ovate- or linear-elliptic, 2.5–8 mm. long; *pedicels* ascending, at anthesis 0.8–1.5 mm., in fruit thickened, 1.2–2.2 mm. long; *bracteoles* commonly 2, often conspicuous, up to 2.5 mm. long; *calyx* 8.2–10.7 mm. long, villousulous with white or rarely some black hairs, the oblique disc 1.5–2 mm. deep, the cylindric, rarely cylindro-campanulate, purplish tube 6.6–8.9 mm. long, 3.3–3.8 mm. in diameter, the subulate or subulate-triangular, acute or obtuse teeth 1.5–3.5 mm. long, the ventral pair often longest; *petals* pink-purple, sometimes pale, little graduated, the wings not over 0.5 mm. shorter than the banner, the keel $\pm$ 1.5 mm. shorter than the wings; *banner* recurved through $\pm$ 40°, oblanceolate or rhombic-oblanceolate, shallowly notched, 16–18.5 mm. long, 6–7 mm. wide; *wings* 15.7–18 mm. long, the claws 8.5–11 mm., the lanceolate, obtuse blades 7.8–8.5 mm. long, 2–2.3 mm. wide below the middle, tapering and slightly incurved distally; *keel* 14.3–16.8 mm. long, the claws 8.3–10.7 mm., the half-obovate blades 6.5–7 mm. long, 2.7–3 mm. wide, incurved through 80–95° to the rounded apex; *anthers* 0.4–0.6 mm. long; *pod* ascending (humistrate), sessile

on the conic receptacle, obliquely lance-oblong in profile, gently incurved throughout, or slightly incurved in the lower half and abruptly so or hooked distally, (1.3) 1.5–2.5 cm. long, 4.5–9 mm. in diameter, obcompressed at base, obtusely obcompressed-triquetrous at the middle, contracted at apex into a triangular, laterally flattened, cuspidate beak, shallowly grooved dorsally from the beak downward, the somewhat fleshy valves becoming stiffly leathery, densely villous-tomentulose with white hairs up to 0.7–1.5 mm. long, inflexed (especially in the lower half) as a narrow but commonly complete septum 0.7–1 mm. wide; *ovules* 18–24; *seeds* not seen.—Collections: 16 (ii); representative: *Munz* 5872 (GH, POM), 15,134 (CAS, POM); *Parish* 1813 (DS, GH, ND, NY, POM), 3744 (GH, ND, P, US); *Hall* 7565 (POM).

Dry pine woods, gravelly knolls among sagebrush, or stony lake shores in the pine belt, 5800–8100 feet, local in the interior mountains of southern California: San Antonio Mountains, Los Angeles County; east end of San Bernardino Mountains, San Bernardino County; Santa Rosa Mountains, Riverside County.—Map No. 85.—May to July.

ASTRAGALUS LEUCOLOBUS (with white-hairy pod) Wats. ex Jones in Zoë 4: 270. 1893.—“Collected by S. B. Parish in Bear Valley on San Bernardino Mountain, Cal., June, 1892.”—Holotypus, POM! isotypi, some dated June 2, 1892, or numbered 2349, ARIZ, NY (2 sheets)! paratypi, *Parish* 1813 & *Parish* Bros. in August, 1882, annotated by Watson and initialed by Jones, GH!—*A. Purshii* var. *leucolobus* (Wats.) Jones, Contrib. West. Bot. 10: 61, Pl. 5. 1902. *Phaca leucoloba* (Wats.) A. Hell., Muhlenbergia 2: 85. 1905 (quoad nom.). *A. inflexus* var. *leucolobus* (Wats.) Jeps., Man. Calif. 573. 1925. *Xylophacos leucolobus* (Wats.) Rydb. in Bull. Torr. Club 52: 371. 1925.

The white-pod milk-vetch, *A. leucolobus*, is so similar in general organization and in most fine details to those forms of *A. Purshii* var. *tinctus* with relatively many (11–17) leaflets that are found immediately to the north of its range in the Mohave Desert and to the northwest in the Coast Ranges, that there can be little doubt about its origins and affinities. The desert phase of var. *tinctus* (minor variant No. 5, as described above) has in common with *A. leucolobus* relatively long-pedunculate racemes and a pod commonly semi- or fully bilocular, but its petals are much more strongly graduated. In the Coast Range form (minor variant No. 6) the flower resembles that of *A. leucolobus*, but the peduncles are short and the pod unilocular. The pod of *A. leucolobus* is peculiar in subsect. *Eriocarpi* less on account of its septum than for its narrow, lance-oblong rather than ovate dorsiventral profile, for the deep dorsal groove extending its whole length downward from the beak, and for its bluntly trigonous compression which approaches that found in subsect. *Pseudargophylli*. In practice the villous-tomentulose vesture of the pod, composed of hairs much shorter than in any of the many variants of var. *tinctus*, provides the most easily observed differential character.

Around Bear and Baldwin Lakes in the San Bernardino Mountains, *A. leucolobus* and the smaller-flowered but rather similar *A. Purshii* var. *lectulus* are sympatric and sometimes directly associated. Both were collected first by Dr. Parry in 1876 and by the Parish Brothers in 1882, 1885, and 1892. Katherine Brandegee suggested, in a footnote to the description of *A. leucolobus*, that the name was a misreading of *A. lectulus*, but this was an error of judgement. A sheet at GH bearing the Parry and two Parish collections of *A. leucolobus* is so annotated by Watson and initialed by Jones. The actual holotypus is, however, a later collection of S. B. Parish in the Jones herbarium at POM.

214. *ASTRAGALUS SUBVESTITUS*

Dwarf, tufted or matted, shortly caulescent, with a slender taproot and closely forking caudex, densely villous-tomentulose throughout with fine, soft, curly, and some longer, straighter hairs up to 0.7–1.2 mm. long, the foliage canescent; *stems* of the year 1–8 cm. long, prostrate, densely leafy, freely branched, forming depressed mats up to 1–2 dm. in diameter, the internodes mostly concealed by stipules, or on vigorous branchlets up to 1 cm. long; *stipules* membranous, ovate or deltoid-acuminate, 2–6 mm. long, semiamplexicaul-decurrent; *leaves* 1.5–4.5 (6.5) cm. long, with slender, basally subpersistent petiole and 7–11 (13) obovate-cuneate and obtuse, less often elliptic and acute, loosely folded or flat

leaflets 2-7 (9) mm. long; *peduncles* 3-30 (45) mm. long, shorter than the leaf, sometimes shorter than the subtending stipules, prostrate in fruit; *racemes* loosely but shortly 3-8-flowered, the axis scarcely elongating, 3-16 mm. long in fruit; *bracts* membranous, triangular-ovate or lanceolate, 2-4 mm. long; *pedicels* ascending, at anthesis 1-2.2 mm., in fruit somewhat thickened, 1.3-2.5 mm. long; *bracteoles* 0; *calyx* 7.5-8.9 mm. long, white-villous like the leaves, the somewhat oblique disc 0.7-0.9 mm. deep, the cylindric or deeply campanulate tube 5.3-6.4 mm. long, 2.3-2.9 mm. in diameter, the subulate teeth 1.4-2.5 (3) mm. long; *petals* whitish, the keel-tip lavender or pink; *banner* gently recurved through $\pm 40^\circ$, oblanceolate, shallowly notched, (11) 11.5-13.3 mm. long, 4.5-5.5 mm. wide; *wings* (10.5) 11-12.1 mm. long, the claws 5.9-6.8 mm., the narrowly oblong, lanceolate, or sometimes transversely dilated and elliptic, obtuse or obliquely truncate, nearly straight blades 5.6-6.2 mm. long, 1.2-2.3 mm. wide; *keel* 9.5-10.7 mm. long, the claws 6-6.6 mm., the obliquely narrow-obovate blades 3.8-4.6 mm. long, 1.9-2.1 mm. wide, incurved through $85-95^\circ$ to the blunt apex; *anthers* 0.5-0.65 mm. long; *pod* ascending (humistrate), obliquely ovoid, 8-15 mm. long, 4.5-6.5 mm. in diameter, obtuse at base, in the lower $\frac{1}{2}$ - $\frac{2}{3}$ obcompressed and dorsally flattened or depressed, thence passing upward into a nearly erect or somewhat incurved, deltoid- or triangular-acuminate, laterally compressed, cuspidate beak, the ventral suture salient, the scarcely fleshy valves becoming stiffly papery, at length brownish-stramineous beneath the vestiture, villous-tomentulose with curly hairs mostly less than 1 mm. long, not inflexed or obscurely so proximally, the septum when present rudimentary, not over 0.2 mm. wide; *dehiscence* apical, after falling; *ovules* 11-14; *seeds* brown, sparsely pitted, 1.6-2 mm. long.—Collections: 5 (o); representative: *J. T. Howell* 26,757, 27,027 (CAS, RSA); *Purpus* 1853 (P, UC); *Twisselmann* 7457 (NY).

Open slopes and gravelly or sandy flats among sagebrush, 8000-8500 feet, rare and local in two small areas on the west slope of the southern Sierra Nevada in California: South Fork of Kern River, Tulare County; Piute Mountains, Kern County.—Map No. 85.—June and July.

ASTRAGALUS SUBVESTITUS (Jeps.) Barneby in Amer. Midl. Nat. 37: 514. 1947, based on *A. leucolobus* var. *subvestitus* (incompletely clothed, of the thinly tomentose pod) Jeps., Fl. Calif. 2: 361. 1936.—"Erskine Creek, Kern Co., *Purpus* 5098 (type)."—Holotypus, collected in 1897, UC! isotypi, GH, POM!

The Monache milk-vetch, *A. subvestitus*, is similar in general appearance and in most technical characters to *A. Purshii* var. *lectulus*, the flowers being almost identical in form and size, although in the present species a little more numerous. The pods, shorn of their vestiture, are also alike in shape and dimensions, but that of *A. subvestitus* is of thinner texture when ripe and lacks the long cottony hairs characteristic of *A. Purshii* as a whole; moreover it encloses scarcely half as many seeds. Jepson postulated a close relationship to *A. leucolobus*, but even though *A. subvestitus* resembles this in its shortly pubescent fruits, the two species differ in almost all other details. Probably both arose by mutation from forms of *A. Purshii*, *A. leucolobus* presumably from *A. Purshii* var. *tinctus*, *A. subvestitus* from *A. Purshii* var. *lectulus*.

In recent years *A. subvestitus* was sought repeatedly along Erskine Creek, but always without success, and there has been some doubt as to the accuracy of Purpus's data, especially since the species is known otherwise only from elevations of approximately 8200 feet in Tulare County. In the summer of 1962 Ernest Twisselmann, the well-known authority on the flora of Kern County, rediscovered the Monache milk-vetch on the summit ridge of the Piute Mountains at 8270 feet elevation. It seems likely that Purpus reached the same peak by way of Erskine Creek, which rises a short distance to the north-northwest, and that Piute Lookout is actually the type-station.

215. *ASTRAGALUS FUNEREUS*

Low, shortly caulescent, loosely tufted, with a woody taproot, densely hirsute and tomentose with nearly straight, spreading, together with shorter, sinuous and

curly hairs up to 1–1.5 mm. long, the herbage canescent, the leaflets equally pubescent on both sides, the inflorescence black-hairy; *stems* 2–8 cm. long, decumbent or prostrate, simple, the internodes short, up to 1–1.5 cm. long but mostly shorter; *stipules* broadly ovate or deltoid-acuminate, submembranous, 3–8 mm. long, semi-to almost fully amplexicaul, the lowest densely pubescent dorsally, the upper thinly so; *leaves* 2.5–7 cm. long, with thick but scarcely persistent petiole and (7) 9–17 usually approximate or crowded, broadly obovate to oblong-obovate or obovate-cuneate, obtuse or emarginate leaflets (2) 3–12 mm. long; *peduncles* stout, at anthesis incurved-ascending, prostrate in fruit, 2.5–6.5 cm. long, $\pm$ equaling the leaf; *racemes* loosely but shortly (3) 4–10-flowered, the flowers ascending, the axis little elongating, 0.5–3 cm. long in fruit; *bracts* submembranous, broadly lanceolate or ovate, 4–6.5 mm. long; *pedicels* ascending, at anthesis 1.7–3 mm., in fruit thickened, persistent, 2.7–4.5 mm. long; *bracteoles* 2, conspicuous and up to 1.2–3 mm. long; *calyx* (11.5) 12.5–16 mm. long, densely hirsute with black or mixed black and white hairs, the subsymmetric disc 1.4–2.2 mm. deep, the membranous, pallid or purplish, cylindro-campanulate tube (8) 9.2–12.4 mm. long, 4.8–6 mm. in diameter, the broadly subulate teeth 3–4.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pink-purple, drying bluish-violet, the banner striate, the wing- and keel-tips maculate; *banner* recurved through $\pm 40^\circ$, broadly oblanceolate or rhombic-spatulate, subentire or openly notched at apex, (2.2) 2.4–2.9 cm. long, 1–1.8 cm. wide; *wings* (2.1) 2.25–2.7 cm. long, the claws (9.5) 10.5–12 mm., the lanceolate or lance-oblong, obtuse, straight blades 14–16.2 mm. long, 2–4.1 mm. wide; *keel* (2.15) 2.4–2.75 cm. long, the claws (10) 11.5–13.5 mm., the obliquely oblanceolate blades 13.5–14.2 mm. long, 5–5.8 mm. wide, gently incurved through $\pm 70^\circ$ to the blunt apex; *anthers* 0.7–1 mm. long; *pod* ascending (humistrate), sessile, obliquely lance-ellipsoid, (2.5) 3–5 cm. long, 1–1.5 cm. in diameter, nearly straight proximally, gently incurved distally and contracted into a laterally compressed, slightly in- or decurved beak ± 6 –10 mm. long, obcompressed toward the base, the fleshy valves becoming leathery, densely hirsute with lustrous, wavy or contorted hairs up to (1.5) 2–2.5 mm. long; *dehiscence* apical, after falling; *ovules* 40–50; *seeds* (little known) brown, ± 3 mm. long.—Collections: 5 (o); representative: *Munz* 16,436 (POM); *Coville & Gilman* 431 (US); *J. T. Howell* 7767 (CAS); *Raven* 12,087 (NY).

Gravelly clay ridges among sagebrush, cliff ledges, or talus under cliffs, sometimes (? always) on limestone, ± 4300 –5000 feet, rare and local, known only from the Grapevine Mountains at the east edge of Death Valley, in Inyo County, California, and perhaps adjoining Nye County, Nevada.—Map No. 85.—April and May.

ASTRAGALUS FUNEREUS (of the Funeral Mountains) Jones, Contrib. West. Bot. 12: 11. 1908.—“... at Rhyolite, Nev., April 11, 1907...”—Holotypus, POM; isotypi, DS, GH, NY (2 sheets), RM!—*Xylophacos funereus* (Jones) Rydb. in Bull. Torr. Club 52: 367 1925. *A. Purshii* var. *funereus* (Jones) Jeps., Fl. Calif. 2: 360. 1936. *A. Newberryi* var. *funereus* (Jones) Clokey in Madroño 6: 214. 1942.

The Funeral milk-vetch is one of our most ornamental astragali. The neat, densely white-tomentose foliage, the baggy, black-hirsute calyces, and the long, pink-purple (when dry bluish-violet) petals of the young plants form a contrast of colors which is especially pleasing. The pods, next to those of *A. coccineus* which they resemble in form and vesture, are the largest of those clothed in a coat of long, silken wool. The species is technically remarkable for the irregular graduation of the petals and the moderate inward curvature of the prominent keel-blades. Jones originally remarked that *A. funereus* combined the habit of *A. utahensis* (or, it might be said with equal force, of some forms of *A. Purshii*) with the fruit of *A. coccineus*, and the form and relative proportions of the petals are quite intermediate between the *Coc-*

cinei and the *Eriocarpi*. A hybrid involving *A. coccineus* and *A. Purshii* var. *tinctus*, which are sympatric in the Death Valley region, might well resemble *A. funereus*.

The species, because of its rarity, has been poorly understood and its name mistakenly applied to forms of *A. Newberryi* with similarly black-hairy calyx; but these are strictly acaulescent plants pubescent with stiffer, straighter, mostly appressed (and never at all tomentose) hairs, and have shorter, more rigid, and more strongly incurved pods. Because of this confusion, *A. funereus* has been reported to range from northwestern Arizona to Tonopah, Nevada, and west to Darwin in the northern Mohave Desert. The genuine Funeral milk-vetch is known, however, only from near Rhyolite (probably, in fact, at some distance from the town, on the east slope of the Grapevine Mountains—cf. Barneby, 1947, p. 486) and from Titus Canyon on the west slope of the range.

216. ASTRAGALUS UTAHENSIS

Low, tufted, and subcaulescent or more commonly diffusely caulescent and loosely matted, with a taproot and shortly forking caudex, the stems and herbage densely pannose-tomentose with extremely fine, entangled, sinuous and curly hairs up to 1.5–2.5 mm. long, the cottony, not at all lustrous vestiture concealing the surface of the white-felted leaflets; *stems* either very short and concealed by stipules, or more commonly developed, prostrate and radiating, up to 1.5 (2) dm. long, the internodes short, up to (but commonly less than) 3.5 cm. long; *stipules* membranous or early becoming so, ovate-triangular, ovate- or lance-acuminate, or -caudate, 3–10 mm. long, semiaxplexicaul-decurrent, dorsally tomentose but sometimes glabrescent distally; *leaves* (1.5) 3–12 cm. long, with flaccid, feebly persistent or deciduous petiole and (5) 9–19 broadly obovate, elliptic-obovate, or suborbicular, obtuse, rarely truncate-emarginate, exceptionally rhombic-ovate and acute, flat or loosely folded leaflets (2) 4–15 mm. long; *peduncles* rather stout, (1) 3–10 cm. long, equaling or shorter than the leaves, ascending at anthesis, prostrate in fruit; *racemes* shortly but loosely, sometimes subumbellately 2–8-flowered, the axis little elongating, 0.5–2.5 cm. long in fruit; *bracts* membranous, lanceolate, lance-, or, more rarely, ovate-acuminate, 4–9 mm. long; *pedicels* ascending, at anthesis 2–3 (3.7) mm., in fruit somewhat thickened, 2.3–4.3 mm. long; *bracteoles* commonly 0, rarely present and up to 1.5 mm. long; *calyx* (12) 13–17 mm. long, villous-tomentose like the herbage but more thinly so, the hairs white or partly fuscous, the obliquely campanulate or obconic disc 1–1.8 mm. deep, the membranous, purplish, broadly cylindric or at length tumid and then oblong-ellipsoid tube (8.5) 9.6–12.8 mm. long, 4.6–5.9 mm. in diameter, the firmer, subulate or lance-subulate teeth (2) 2.4–4 (4.7) mm. long; *petals* bright pink-purple, with a pale striate eye in banner; *banner* recurved through $\pm 45^\circ$, broadly oblanceolate or rhombic-spatulate, (21) 24–29 (31) mm. long, 10.5–15 (16.5) mm. wide; *wings* (19) 22–27 mm. long, the claws 11–14 (14.5) mm., the linear- or lance-oblong, obtuse, straight or slightly incurved blades 12–14.5 mm. long, 2.8–3.8 mm. wide; *keel* (16) 17–22 mm. long, the claws 11–14 mm., the lunate blades 7–8.9 mm. long, 3–3.9 mm. wide, gently incurved through 80–100° to the rounded apex; *anthers* 0.6–0.8 mm. long; *pod* ascending (humistrate), sessile on a glabrous, stipelike gynophore (1) 1.4–2.5 mm. long, the body (shorn of the vestiture) lance-ellipsoid or narrowly ovoid-acuminate, 1.7–3 (3.5) cm. long, (5) 5.5–7.5 mm. in diameter, broadly cuneate or rounded at base, tapering gradually (rarely abruptly) into the erect or slightly incurved, laterally compressed beak, elsewhere obcompressed, openly and shallowly sulcate ventrally at and below the middle, a trifle sulcate or merely flattened dorsally, the thinly fleshy valves becoming stiffly papery or thinly leathery, reticulate, 0.2–0.3 mm. thick when ripe, so densely shaggy-villous with fine, horizontally spreading, lustrous, silky, cream-colored or pale yellow hairs 4–8 mm. long as to conceal the shape and surface of the fruit; *dehiscence* apical, tardy; *ovules* (22) 25–31; *seeds* light or dark brown,

smooth or nearly so but scarcely lustrous, 2.1–3 mm. long.—Collections: 76 (x); representative: *J. & C. Christ* 19,769 (ID, NY); *Ripley & Barneby* 3588, 4417, 6231 (CAS, RSA); *Watson* 275 (GH, NY); *Tidestrom* 2108 (GH, NY); *Jones* 5324 (POM, NY).

Dry stony hillsides, open gravelly banks and river terraces, with sagebrush, oak brush, and junipers, 4100–7000 feet, especially abundant and vigorous on calcareous soils but not rare on other sedimentary and sometimes on granitic bedrock, common about Utah and Great Salt Lakes, Utah, south along the Sevier to Piute County, extending across the Wahsatch to the upper Price River and the edge of the Uinta Basin in Carbon and Duchesne Counties, north to the Bear River Valley in extreme southwestern Wyoming and to Bannock and Bear Lake Counties in southeastern Idaho; west through the limestone ranges of eastcentral Nevada to southern Eureka and northern Nye Counties—Map No. 88.—Late April to July, rarely again in fall.

ASTRAGALUS UTAHENSIS (Torr.) T. & G. in Pac. R. R. Rep. 2: 120. 1855, based on *Phaca mollissima* var. *utahensis* (of Utah) Torr. ap. Stansbury, Expl. Great Salt Lake 385, Pl. II. 1853 ("Utahensis").—"Shores and islands of the Salt Lake."—Holotypus, labeled "West shore of Great Salt Lake, June 24, 1850, Stansbury," NY! Stansbury collections at GH, K, are presumably isotypi!—*Tragacantha utahensis* (Torr.) O. Kze., Rev. Gen. 949. 1891. *Xylophacos utahensis* (Torr.) Rydb. in Bull. Torr. Club 40: 49. 1913.

Astragalus utahensis fma. *umbellulatus* (with flowers in small umbels) Gand. in Bull. Soc. Bot. Fr. 48: xvi. 1902 ("*umbellulata*").—"A. Nelson exs. no. 4514 . . . Hab. Wyoming, ad Evans-ton (A. Nelson)."—Holotypus, dated June 4, 1898, LY! isotypi, GH, NY, PH, WS!

The Utah milk-vetch was singled out by Jones as the state's most beautiful flower; at very least it is one of the region's most ornamental astragali. The generously proportioned and richly colored flowers are set off to advantage by the cottony tomentum of the foliage, and the pods, which so greatly excited the admiration of the early collectors on account of the dense silken vesture, are at once curious and handsome.

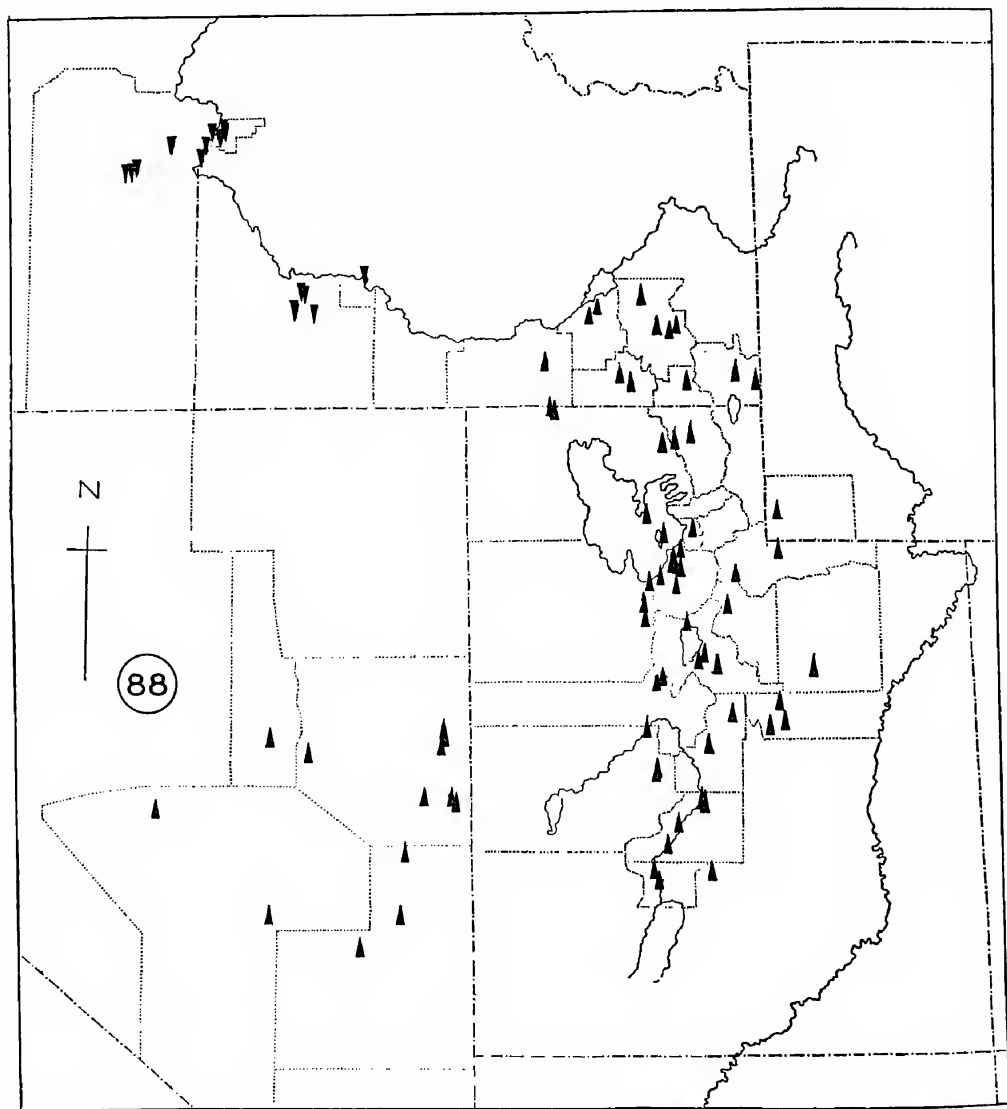
The relationship of *A. utahensis* to the *A. Purshii* complex is a close one. Early collections of *A. Purshii* var. *concinus*, which superficially resembles the Utah milk-vetch in both foliage and flower, were long confused with it. The ordinarily fewer leaflets and the rigid, incurved pod of its species serve to distinguish var. *concinus*, which has moreover a much more northern range than *A. utahensis*. The only form of *A. Purshii* found within the range of *A. utahensis* is var. *Purshii*, easily distinguished by its narrow leaflets and ochroleucous petals.

According to Stapf (in Curtis, Bot. Mag. Tab. 9302. 1933) the Utah milk-vetch was in English gardens about 1926, but it seems to have been lost to cultivation subsequently. The *Argophylli* are potentially perennial but are of rapid growth and short duration even in nature; under garden conditions they thrive only briefly and often fail to produce viable seed.

217. ASTRAGALUS NUDISILIQUEUS

Caulescent, diffuse or prostrate, with a taproot and loosely forking, rather soft caudex, densely villous-tomentose throughout with fine, shorter, curly together with longer, straighter, ascending and spreading hairs up to (0.8) 1–1.5 mm. long, the stems white-felted, the herbage silky-canescens in youth, becoming white-cottony late in the season, the leaflets usually equally pubescent on both sides, rarely more thinly so and greenish above; stems several or numerous, radiating, (2) 5–25 (30) cm. long, commonly branched below the middle, together forming loosely woven mats, the longer internodes up to 1–3.5 cm. long; stipules thinly herbaceous becoming membranous, ovate or lanceolate, acute or acuminate, (1.5) 3–7 mm. long, semi- or almost fully amplexicaul-decurrent; leaves 3–11 cm. long, with flaccid, wholly deciduous petiole and (7) 11–17 broadly obovate, obovate-cuneate, or broadly oblanceolate, mostly obtuse, less often subacute or subretuse, flat or loosely folded leaflets 4–17 mm. long; peduncles 1–7 cm. long, incurved-ascending at anthesis, prostrate in fruit; racemes shortly and loosely (2) 4–8-flowered, the axis little elongating, 0.5–2.5 cm. long in fruit; bracts membranous with green midrib, linear-lanceolate, lance-acuminate, or rarely ovate, (1.5) 3–6

mm. long; *pedicels* ascending or somewhat arcuate in age, at anthesis slender, 1.4–2.8 mm., in fruit thickened, 2–3.4 mm. long; *bracteoles* 0–2, sometimes conspicuous and up to 2 mm. long; *calyx* (14.6) 15–18.8 mm. long, thinly villosulous with white or white and a few black hairs, the subsymmetric disc 1.6–2.7 mm. deep, the membranous, purplish, cylindric tube (11.3) 12–13.8 mm. long, 4.2–5 (5.5) mm. in diameter, the subulate or subulate-setaceous teeth (2) 3–5 mm. long; *petals* pink-purple, the banner with a pale, striate eye, the color fugitive when dried; *banner* recurved through $\pm 40^\circ$, spatulate-oblongate, 20.5–25.5 mm. long, the claws 11.4–14 mm., the lanceolate, obtuse blades (8.1) 9–11 mm. long, 2.5–3 mm. wide, gently incurved in the distal $\frac{1}{3}$; *keel* 17.4–21.3 mm. long, the claws 11.2–14.3 mm., the lunately half-obovate blades 6.6–8 mm. long, 2.7–3.3 mm. wide; *anthers* 0.5–0.7 mm. long; *pod* ascending (humistrate), obliquely ovoid



Map No. 88. Utah and parts of adjoining states. Range of $\blacktriangle$ *A. utahensis*; and of $\blacklozenge$ *A. nudisiliqus*.

or oblong-ellipsoid, (1.5) 2–3.5 (4.5) cm. long, (8) 9–13 mm. in diameter, at base rounded, broadly cuneate, or abruptly contracted into a short, obconic neck, strongly obcompressed, openly depressed-sulcate ventrally and flattened dorsally through the proximal $\frac{2}{3}$ or more, thence passing upward into a strongly incurved or even backwardly hooked, triangular- or lance-acuminate, laterally compressed beak, the green, fleshy valves becoming stiffly leathery, brown or stramineous, and (0.5) 0.6–1 mm. thick when ripe, faintly rugulose and also wrinkled lengthwise along either side of the thick ventral suture, not inflexed, but the dorsal suture sometimes thickened and slightly elevated within, the whole relatively thinly villous-hirsute with lustrous, spreading hairs up to 1.6–2.5 (3) mm. long, the vesture not concealing the surface of the valves, sometimes deciduous in extreme age; *dehiscence* apical, after falling; *ovules* 30–41; *seeds* brown or nearly black, sparsely pitted, dull, 2.3–2.8 mm. long.—Collections: 15 (v); representative: *Cusick 1951a* (GH, ORE, POM); *Ripley & Barneby 6121* (CAS, GH, RSA), 6484 (CAS, IDS, NY, RSA); *J. & C. Christ 17,277, 17,287* (ID, NY, RSA); *C. L. Hitchcock 20,625* (NY).

Summits and gullied slopes of river bluffs and terraces, in sandy clay or cobblestone alluvia, 2100–3300 feet, locally plentiful along the Snake and the lower Malheur and Bruneau Rivers about the west end of the Snake River Plains, from northern Malheur County, Oregon, and Payette County, Idaho, upstream to Elmore County.—Map No. 88.—Late April to early July.

ASTRAGALUS NUDISILIQUEUS (with naked pod) A. Nels. in Bot. Gaz. 54: 410. 1912.—“Secured by NELSON and MACBRIDE on the steep cobblestone bluffs of the Snake River, at King Hill, Idaho, July 15, 1911, no. 1088.”—Holotypus, RM! isotypus, GH!—*Xylophacos nudisiliquus* (A. Nels.) Rydb. in Bull. Torr. Club 52: 368. 1925.

The cobblestone milk-vetch—its epithet *nudisiliquus* is ordinarily inappropriate and misleading—is quite similar to *A. utahensis* in habit of growth, in vesture, and in detail of the only slightly less handsome and amply proportioned flower. It is distinguished principally by the broader, often longer, at first fleshy and ultimately subligneous pod which is, by comparison with the majority of the *Eriocarpi*, only thinly hirsute, the hairs being spaced so as to reveal the surface of the valves. The vesture is deciduous only in extreme age, as shown in the type-collection, where the pod had already (by mid-July) fallen and split open to release the seeds. Two other purple-flowered *Eriocarpi* are found in the same range as *A. nudisiliquus*, one (*A. Purshii* var. *glareosus*) at greater elevations and in less specialized environment, the other (*A. Purshii* var. *ophiogenes*) in almost identical habitats. The var. *glareosus* has flowers of about the same size but fewer, and shorter, ordinarily tufted stems; the var. *ophiogenes* has flowers hardly half as large.

218. *ASTRAGALUS INFLEXUS*

Caulescent, diffuse, with a taproot and an ultimately branched but hardly woody caudex, densely villous or villous-tomentose, rarely pannose-tomentose throughout or nearly so with extremely fine, variously proportioned shorter, curly and entangled hairs together with longer, straighter, loosely ascending or spreading ones up to 1.3–2 (2.5) mm. long, the herbage greenish-gray or white-woolly; *stems* several, prostrate and radiating, or with incurved-ascending tips, mostly 1–3.5 (5) dm. (in occasional young or starveling individuals only 0.5 dm.) long, simple or bearing a few short branches or spurs below the middle, zigzag distally, almost always composed of several, often of many well-developed internodes up to 2–6 cm. long, together forming loose, leafy mats; *stipules* submembranous, ovate-, triangular-, or lance-acuminate or -caudate, 5–12 (16) mm. long, semi-amplexicaul-decurrent; *leaves* (3) 4–12 (16) cm. long, the lowest petioled, the upper ones very shortly so or sessile, with 17–23 (27), or in some lower leaves as few as 9, obovate-cuneate, rhombic-oval, or broadly oblanceolate, acute, sub-acute, or shortly acuminate, rarely subobtusate, flat or loosely folded leaflets (4)

6–16 (20) mm. long; *peduncles* divaricate or incurved-ascending, (2) 3–8 cm. long, shorter or sometimes a trifle longer than the leaf, not recurved in fruit; *racemes* loosely (5) 8–18-flowered, the axis somewhat elongating, (1.5) 2.5–6 (8) cm. long in fruit; *bracts* submembranous, lanceolate or lance-acuminate, 4.5–10 mm. long; *pedicels* ascending, straight or nearly so, at anthesis slender, (1.3) 1.8–2.8 mm., in fruit thickened, 2–3.3 mm. long; *bracteoles* 0; *calyx* (9.4) 11.3–16.4 mm. long, usually purplish, villous with white or rarely some black hairs, the somewhat oblique, campanulate or funnelform disc 1.2–2.1 mm. deep, the cylindrical or rarely cylindro-campanulate tube (6.2) 8.2–10.2 mm. long, 3.7–5.2 mm. in diameter, the linear-lanceolate or lance-caudate teeth 3.1–6.6 (7) mm. long; *petals* pink-purple, the banner with a pale, striate lozenge in the fold; *banner* recurved through $\pm 40^\circ$, oblanceolate, rhombic-oblanceolate, or -obovate, (16.5) 19.5–23 mm. long, 8.4–11 (14.5) mm. wide; *wings* (14) 18.2–20.2 mm. long, the claws (8) 9–11.8 mm., the oblong-elliptic or lance-oblong, obtuse or rarely obliquely emarginate, nearly straight blades (6.7) 8.2–11.2 mm. long, 2.2–3.2 (3.9) mm. wide; *keel* (12.7) 14.4–17.2 mm. long, the claws (8.2) 8.5–11.7 mm., the lunately elliptic or half-obovate blades (5.2) 5.9–6.8 mm. long, (2) 2.5–3.3 mm. wide, rather abruptly incurved through $90\text{--}100^\circ$ to the blunt apex; *anthers* 0.55–0.65 mm. long; *pod* ascending or strongly incurved-ascending, sessile on an obscure gynophore (0.5) 0.7–1.8 mm. long, obliquely ovoid, lance-ovoid, or oblong-ellipsoid, (1.3) 1.5–2.5 (3) cm. long, (5) 7–9.5 mm. in diameter, obtuse or obtusely cuneate at base, in the lower $\frac{1}{2}\text{--}\frac{2}{3}$ straight or nearly so, obcompressed, and openly sulcate at least ventrally and commonly also dorsally, thence $\pm$ abruptly tapering and incurved through $\pm 90^\circ$ into the broadly deltoid- to narrowly triangular-acuminate, laterally compressed beak, the somewhat fleshy, green valves becoming stiffly leathery, stramineous or brownish, reticulate, villous-hirsute or exceptionally tomentose with variably proportioned shorter, curly hairs and longer, ascending or spreading, straighter ones up to (1) 1.3–2.2 mm. long, the shaggy vesture rarely concealing the whole surface and never the shape of the fruit, the valves not inflexed, but the sutures approximate or contiguous within, the cross-section deeply cordate or subdidymous; *dehiscence* apical, through the gaping beak; *ovules* 22–28 (33); *seeds* ocher-, olive-, or mahogany-brown, sometimes almost black, smooth or very sparsely pitted, dull, 1.7–2.8 mm. long.—Collections: 105 (iv); representative: *Jones* (from Riparia, Washington) in 1905 (CAS, GH, NY, POM, WTU); *Piper* 2938 (GH, NY, POM, WS, WTU); *Ripley & Barneby* 10,708 (CAS, NY, IDS, RM, RSA), 8867 (CAS, RSA, UTC, WTU); *Hitchcock & Muhlick* 11,808 (CAS, RSA, WS).

Open grassy hillsides, dry pastures, valley floors, and river terraces, in light dry alluvial soils derived from basalt or granite bedrock, rarely in yellow pine forest, (600) 1100–4200 feet, locally abundant but apparently of discontinuous distribution: most frequent along the lower Snake, Salmon, Clearwater, and Palouse Rivers and their tributary streams in southeastern Washington, north-eastern Oregon, and westcentral Idaho, extending in Washington feebly downstream along the Snake River to its confluence with the Columbia and north into Spokane County; western Montana, west of the Continental Divide, from Flat-head Lake south to the Bitterroot Valley; upper Missouri Valley, Montana, from near the mouth of the Belt River upstream to the lower Madison River—Map. No. 89.—May to early July.

ASTRAGALUS INFLEXUS (bent inward, of the pod's beak) Dougl. ex Hook., Fl. Bor.-Amer. 1: 151. 1831.—“On the barren sandy grounds of the Columbia, from the junction of Lewis and Clarke's River to the mountains. *Douglas*.”—Holotypus, K! isotypi, BM, P!—*Tragacantha inflexa* (Dougl.) O. Kze., Rev. Gen. 945. 1891. *Phaca inflexa* (Dougl.) Piper in Contrib. U. S.

Nat. Herb. 11 (Fl. Wash.): 369. 1906. *Xylophacos inflexus* (Dougl.) Rydb. in Bull. Torr. Club 40: 49. 1913.

Prominent features of the bent milk-vetch, *A. inflexus*, other than the cottony vesture common to the *Eriocarp*i, are the well-developed, distally flexuous stems, the subsessile upper leaves composed of relatively numerous (mostly 17–23) leaflets, the racemes of some dozen or more flowers, and the long, often caudate-acuminate stipules echoed in the inflorescence by long bracts and calyx-teeth. No single one of these characters is consistently diagnostic of the species; but in practice there is scarcely ever any doubt as to its identity, except in rare cases of plants collected in early flower, or for some reason depauperate. Some of these have been mistaken for *A. Purshii* var. *glareosus*, and Jones speaks (1923, p. 221) of "puzzling intergrades" between *A. inflexus* and var. *glareosus* found "above the great bend of the Snake River at Huntingdon (i.e., upstream from the Baker-Malheur County line in Oregon and in adjacent Idaho). Plentiful material from this area is now available, all of it, with the exception of one record (north of Weiser, *Sharpe 17,189*, NY) of typical *A. inflexus*, to be referred to var. *glareosus* sens. strict. The ranges of these two astragali overlap elsewhere only along the Columbia River near the Great Bend in Washington, and here *A. inflexus* is confined to the immediate banks of the river and is probably a recent immigrant by way of seeds brought down by the flood waters of the Snake. Over most of its range *A. inflexus* is the only member of its group with purple flowers.

A superficially remarkable form of the bent milk-vetch, but probably no more than a minor variant, is known from a thriving, apparently uniform population established on a dune of river sand in the bed of the Salmon River canyon north of Riggins, Idaho (*Ripley & Barneby 10,728*). The plants differ from normal hirsute or both hirsute and tomentulose *A. inflexus* in being cottony-pannose throughout, the vesture (which resembles that of *A. utahensis* in quality) extending even to the pods. More material from the Salmon canyon is needed.

LVI (vii). Subsectio PARRYANI

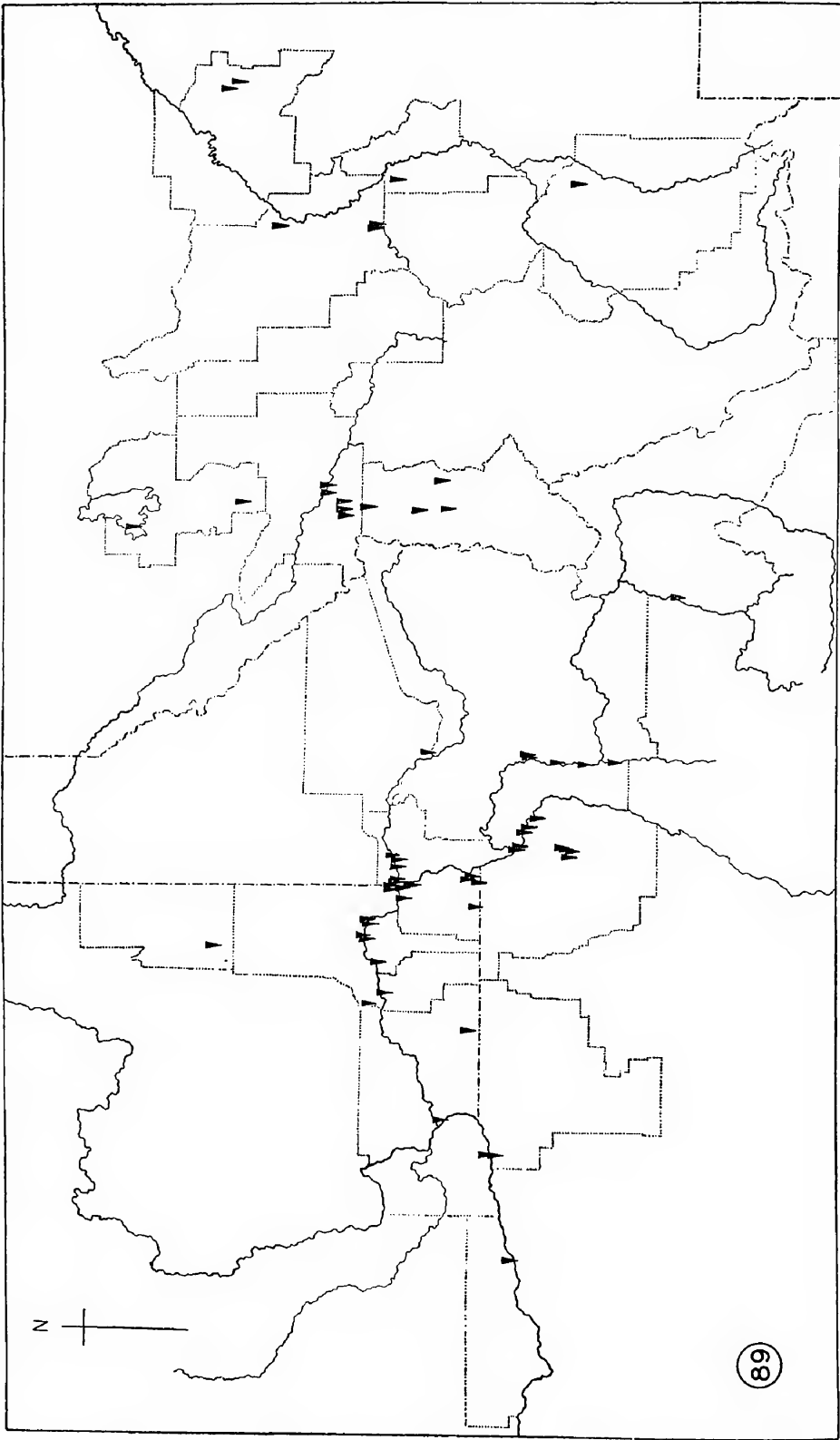
Shortly caulescent; *vesture* hirsute; *stipules* free; *leaflets* rather numerous (mostly 15–27); *calyx-tube* broadly campanulate, more rarely subcylindric; *petals* white, sometimes pink-veined, of moderate size, the banner 15–22 mm. long; *pod* nearly of subsect. *Argophylli*, but grooved along both sutures, the cross section didymous; *ovules* 26–30:—Sp. 1, xerophyte, of the southern Rocky Mountains, southeastern Wyoming and Colorado.

ASTRAGALUS sect. ARGOPHYLLI subsect. PARRYANI, subsect. nov., adpectu proprio potius quam notulis gravibus ab *Argophyllis* genuinis absimilis, pube hirsuta, calyce profunde fisso et propterea tubo suo saepissime late campanulato, petalis albis nunc roseo-striatis -suffusive, et leguminis secus utramque suturam sulcati sectioni didymo praestans.—Sp. unica: *A. Parryi* Gray.

The single member of subsect. *Parryani* is a somewhat isolated species of doubtful affinity. It was associated by Jones (1923, p. 255, in clave, p. 256) with *A. feensis* in sect. *Malaci* and transferred by Rydberg to *Batidophaca* sect. *Villosae*, a heterogeneous and patently unnatural group which provided no more than a dumping ground for species for which no more appropriate pigeonhole could be found. Earlier Rydberg (1905, l.c. inf.) had referred *A. Parryi* to *Xylophacos*, a genus essentially equivalent to our *Argophylli*, where it was originally placed by Gray (1864, p. 211). I excluded it (1947, p. 424) from sect. *Argophylli* on admittedly flimsy grounds; important differential characters are lacking. The peculiar facies of *A. Parryi* is derived from a combination of hirsute pubescence, relatively many leaflets, ordinarily broadly campanulate, deeply toothed calyx, white petals (commonly veined and sometimes suffused with pink), and a pod so deeply sulcate both ventrally and dorsally below the beak as to bring the sutures into contact within and divide the cavity into parallel tubes. In so far that no close or immediate relationship to any other particular member of sect. *Argophylli* has been demonstrated, it seems best to set *A. Parryi* apart in a subsection of its own.

219. ASTRAGALUS PARRYI

Low, loosely tufted, caulescent, the stems and herbage hirsute with fine, spreading and often contorted, basifixed hairs up to 1–2 mm. long, canescent or greenish, the leaflets often glabrescent above; *stems* several, decumbent, simple, 3–25 cm. long, arising from the superficial root-crown or, in old plants, from a shortly forking caudex; *stipules* thinly herbaceous becoming papery-membranous,



ovate-acuminate or lanceolate, 5–10 mm. long, semiamplexicaul-decurrent; *leaves* (2) 4–14 cm. long, shortly petioled, with (9) 15–27 variably shaped leaflets 4–15 mm. long, those of the shorter, primary leaves commonly small, broadly ovate or obcordate, those of the upper leaves larger, obovate to broadly oblanceolate or elliptic, obtuse or rarely acute; *peduncles* slender, 2–5.5 cm. long, often less than $\frac{1}{2}$ as long as the subtending leaf, incurved-ascending at anthesis, prostrate in fruit; *racemes* shortly but loosely 4–9-flowered, the flowers loosely ascending, the axis little elongating, 1–2.5 cm. long in fruit; *bracts* lance-acuminate, 3.5–9 mm. long; *pedicels* ascending, at anthesis slender, $\pm$ 2 mm., in fruit thickened, 2.5–4 mm. long; *bracteoles* 0–2; *calyx* 9–12 mm. long, hirsute with white or mixed black and white hairs over 1 mm. long, the oblique disc 0.5–1.2 mm. deep, the submembranous, broadly campanulate or more rarely subcylindric tube 5–7 mm. long, 3–4.8 mm. in diameter, the narrowly lanceolate teeth $\pm$ 4–5 mm. long; *petals* white, or white with pink veins and keel-tip, rarely roseate throughout; *banner* recurved through $\pm$ 45°, 15–22 mm. long, the narrowly cuneate claw expanded into an ovate blade 8.2–12 mm. wide; *wings* 14–18 mm. long, the claws 7–8.2 mm., the obliquely oblanceolate or obovate, obtuse or emarginate blades 9.8–12.1 mm. long, 3–5 mm. wide; *keel* 12.4–16.2 mm. long, the claws 6.5–8.1 mm., the lunate blades 6.9–9.4 mm. long, 2.4–3.5 mm. wide, incurved through $\pm$ 45° to the deltoid, sometimes obscurely porrect apex; *anthers* 0.7–0.85 mm. long; *pod* loosely ascending or spreading (humistrate), lunately lanceolate in profile, incurved through $\frac{1}{5}$ – $\frac{1}{2}$, or rarely coiled into nearly a full circle, strongly obcompressed and sulcate along both sutures in the lower $\frac{1}{2}$ – $\frac{2}{3}$, thence passing upward into an acuminate, often long-acuminate, laterally compressed beak, the sutures thickened and prominent even though depressed, subcontiguous within the cavity, the dorsal one commonly undulate, the fleshy, green valves becoming brownish, stiffly leathery or subligneous, rugulose-reticulate, densely hirsutulous with white hairs, not inflexed; *dehiscence* apical, after falling; *seeds* olive-brown or castaneous, smooth, 2.2–2.5 mm. long.—Collections: 40 (ix); representative: *C. L. Porter* 3111, 3209 (RM, WTU); *Ripley & Barneby* 7226 (CAS, RSA), 7686 (CAS, GH, NY, RSA, UTC), 10,414 (RSA); *Rydberg & Vreeland* 5968 (NY, WS).

Open gravelly or sandy banks and hillsides, in sagebrush, about oak thickets, and in open pine forest, commonly on granite, occasionally on sandstone, 5800–10,000 feet, locally plentiful along the east slope and foothills of the Rocky Mountains, from the Medicine Bow Range in Albany County, Wyoming, south to the Spanish Peaks in Huerfano County, Colorado, extending rarely west of the Continental Divide to the headwaters of the Grand River in Grand County; reports from western Texas and northern New Mexico are based on misdeterminations.—Map No. 90.—May to July.

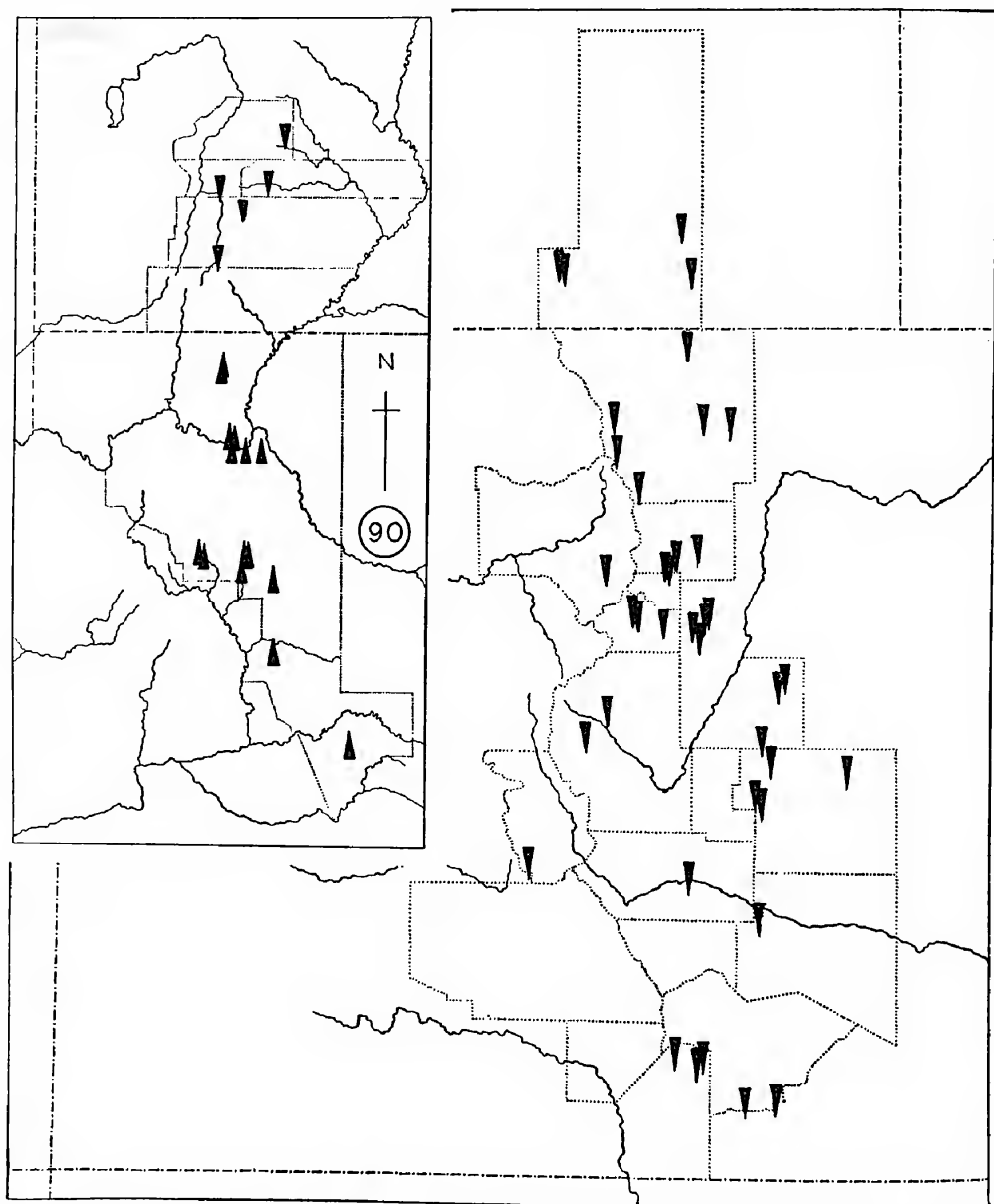
ASTRAGALUS PARRYI (Charles Christopher Parry, 1823–1890, pioneer plant collector in the s. Rocky Mountains) Gray in Amer. Jour. Sci. II, 33: 410. 1862.—“Common on dry gravelly banks along Clear Creek . . . Pope collected it in flower on the Llano Estacado and Mr. Gordon . . . in the Raton Mts.”—Lectotypus, *Parry* 193 in 1861, GH! isotypus, K!—The paratypes represent other species, Pope’s plant (GH) = probably *A. plattensis*, Gordon’s (GH) from “Ratoon” is fragmentary and unidentifiable.—*Tragacantha Parryi* (Gray) O. Kze., Rev. Gen. 947. 1891. *Xylophacos Parryi* (Gray) Rydb. in Bull. Torr. Club 32: 662. 1905. *Batidophaca Parryi* (Gray) Rydb. in N. Amer. Fl. 24: 318. 1929.

The Parry milk-vetch is an attractive plant, notable for its hirsute foliage and white, sometimes pink-veined or roseate flowers; it resembles no other species found in the same region and is seldom if ever misidentified. The calyx varies considerably in width, the tube becoming

either broadly campanulate or subcylindric. A broad tube associated with ample petals and deep calycine disc is by far the commoner form; plants of this type are probably normal for the species. The pod varies in length and curvature, but not more so than in other *Argophylli*. In other respects *A. Parryi* is rather uniform in appearance and detail.

LVI (viii). Subsectio MISSOURIENSES

Acaulescent or shortly caulescent, tufted or prostrate perennials, sometimes flowering the first season; *pubescence* dolabriform; *stipules* free (the lowest connate in one form of *A. missouriensis*); *leaflets* mostly 5–21, or only 1–7 in juvenile



Map No. 90. Left, northwestern Arizona and southwestern Utah. Range of *A. castaneiformis*: ▲ var. *castaneiformis*; and ▼ var. *consobrinus*. Right, the Rocky Mountains of Colorado and southern Wyoming. Range of *A. Parryi*.

plants; *flowers* few (2–12, rarely 15), ascending or spreading in age; *calyx-tube* cylindric or deeply campanulate (in *A. musimonum* and *A. accumbens* campanulate); *petals* pink-purple or whitish, regularly (in *A. musimonum* little) graduated; *pod* ascending (humistrate), deciduous or (in *A. missouriensis* and *A. accumbens*) persistent, variable in size, shape, compression, and curvature, from ovoid-subglobose to narrowly oblong or crescentic, straight to very strongly incurved, dorsiventrally or laterally compressed, the $\pm$ fleshy valves becoming leathery, subligneous, or alveolate-spongy, not inflexed, or if so then very narrowly, the obscure septum not over 1 mm. wide; *dehiscence* various; *ovules* 18–70.—Spp. 7, xerophytes, of western United States and southern Canada (southern Alberta and Saskatchewan to western Texas, western Wyoming, central Arizona, and southern Nevada).

ASTRAGALUS sect. ARGOPHYLLI subsect. MISSOURIENSES Jones, Rev. Astrag. 200, in clave. 1923.—Sp. typica: *A. missouriensis* Nutt.—*Xylophacos* sect. *Missourienses* Rydb. in Bull. Torr. Club 52: 144, in clave. 1925.

Astragalus sect. *Lotiflori* subsect. *Accumbentes* Jones, Rev. Astrag. 175, in clave. 1923.—Sp. typica: *A. accumbens* Sheld.

Xylophacos sect. *Pygmaei* Rydb. in Bull. Torr. Club 52: 144, in clave. 1925.—Sp. typica: *X. pygmaeus* (Nutt.) Rydb. = *A. Chamaeleuce* Gray.

The subsect. *Missourienses* is neatly circumscribed and defined by the presence of dola-briform hairs, but it would be hazardous to assume that it is a truly natural monophyletic group. On the contrary, it seems possible that the species have arisen independently, either singly or in pairs, from already existing *Argophylli* with basifixed vestiture or from precursors of these at some more remote period in the past. The close resemblance of *A. (Argophylli) Tidestromii* to *A. (Missourienses) amphioxys* has been discussed under the former. There are also suggestive correspondences in general facies and in particular details of structure between *A. castaneiformis* and *A. Chamaeleuce* of the present subsection and *A. argophyllus* and *A. Shortianus* of the genuine *Argophylli*. Whatever the truth of the matter, the subsectional category is too useful to be abandoned.

Considered either individually or collectively, the *Missourienses* have reached a high level of specialization, particularly in the fruit. Especially noteworthy are the alveolate-pithy pod of *A. Chamaeleuce*, the unique dehiscence of *A. cymboides*, and the marcescent pods of *A. missouriensis* and *A. accumbens*, in which the course of evolution from the emmenoloboid to the ptioloboid condition has been reversed. The presumably recent, parallel mutations, expressed in an abrupt shortening of the flower and in consequence a change in shape and proportions of its parts, which have given rise to *A. accumbens* and *A. musimonum*, are evidence of continued evolutionary activity in the group. The tendency in *A. amphioxys* toward a short life-span denotes an advanced stage in another direction.

Key to the Species of Subsect. *Missourienses*

1. Flowers very small, the calyx 4.6–5.1 mm., the banner (broadly obovate-cuneate, ochroleucous veined or suffused with lilac) 7–8.3 mm. long, the keel 6.9–7.8 mm. long; *pod* plumply ovoid or oblong-ellipsoid, persistent on the receptacle; Zuñi Mountains, McKinley County, New Mexico 226. *A. accumbens*
1. Flower larger, the calyx 5.3–15.5 mm., the banner (mostly oblanceolate, if obovate-cuneate then pink-purple) 10.3–28 mm. long, the keel 9.8–22.7 mm. long; *pod* variable in shape, early deciduous except in *A. missouriensis* (2)
2. Leaflets 3–5, mostly large, 1–3.5 cm. long; *petioles* persistent on the root-crown; *plants* strictly acaulescent; *pod* alveolate-spongy when ripe; Colorado Basin in Utah; cf. *A. (Newberryani) musiniensis*.
2. Leaflets 7 or more in mature leaves (fewer only in seedling plants, or in some lower leaves) (3)
3. Pod obliquely ovoid to narrowly ellipsoid, mostly incurved, but if straight then dorsiventrally compressed either at base or at the middle, one or both sutures $\pm$ depressed (4)
4. Pod hirsute with spreading, lustrous, basifixed hairs up to 2 mm. long; very local in centr. Utah; cf. *A. (Newberryani) loanus*.
4. Pod strigulose, the hairs appressed or subappressed and much shorter (5)
5. Walls of the pod at least 1 mm. thick, the exocarp and endocarp separated by a thick, at first pulpy mesocarp which becomes alveolate-spongy when

- ripe; basins of the Green and Grand Rivers, s.-e. Utah, w. Colorado, n. through w. Wyoming to the Big Horn River 221. *A. Chamaeleuce*
5. Walls of the pod much less than 1 mm. thick, becoming leathery or stiffly papery when ripe; widespread from s. Utah and s.-w. Colorado to s. Nevada and w. Texas (6)
6. Calyx-tube shortly campanulate, 3.4–4.2 mm. long; *pod* crescentic, 1.5–2.5 cm. long, laterally compressed at both ends, the beak strongly hooked backward; local in calcareous desert, Clark County, Nevada 223. *A. musimonum*
6. Calyx-tube deeply campanulate to cylindric, 4.7–13.2 mm. long; *pod* variable in shape and curvature, but either more than 2 cm. long or, if shorter, then dorsiventrally compressed at base, or if laterally compressed the beak only moderately incurved to erect; widespread (but only *A. amphioxys* in Clark County) (7)
7. Pod variable in shape and curvature, but commonly crescentic and mostly 2–5 cm. long, nearly always laterally compressed at both ends and obcompressed or obcompressed-triquetrous at the middle; *flowers* variable in size but nearly always pink-purple; *ovules* 40–70; widespread on arid plains and deserts, mostly below 6000 ft. (if higher the flowers always large and range different from the next) (8)
8. Pod readily deciduous; widespread from s. Utah and s. Nevada to s.-w. Colorado and w. Texas 222. *A. amphioxys*
8. Pod persistent (or very tardily deciduous); local in s.-w. Colorado and adjoining Utah 225b. *A. missouriensis* var. *amphibolus*
7. Pod plumply ovate to broadly lanceolate in outline, scarcely to moderately incurved, 9–22 mm. long, laterally compressed only in the beak; *flowers* mostly small, the petals whitish or purple-tinged, the calyx-tube 4.7–8 mm., the banner 11–18.5 mm., the keel 8.3–14.3 mm. long; *ovules* 18–33; plateaus of centr. and n. Arizona and centr. Utah, 6000–8000 ft. 220. *A. castaneiformis*
3. Pod narrowly oblong to oblong-ellipsoid, straight or nearly so, laterally compressed when ripe, bicarinate by the sutures (9)
9. Pod persistent on the receptacle, becoming leathery in age, dehiscent through the gaping beak, the exocarp not exfoliating; *petals* bright pink-purple; plains and e. foothills of the Rocky Mountains from s. Canada to w. Texas and the Rio Grande Valley in New Mexico, extending w. of the Continental Divide only to the upper San Juan Valley in s.-w. Colorado 225. *A. missouriensis*
9. Pod readily deciduous, the exocarp splitting along the length of the ventral suture and exfoliating as two recurving, papery wings, thus exposing the $\pm$ spongy-alveolate or pithy mesocarp; *petals* usually whitish tinged with lilac, perhaps sometimes purple; local at low elevations in the Colorado Basin, e.-centr. Utah 224. *A. cymbooides*

220. ASTRAGALUS CASTANEIFORMIS

Low or dwarf, densely tufted, acaulescent or subacaulescent, with a taproot and cespitose, pluricipital crown or shortly and closely forking caudex, densely strigose or strigulose throughout with straight or almost straight, appressed and often some narrowly ascending hairs up to 0.7–1.25 mm. long, the herbage gray or silvery, sometimes greenish in age; *stems* commonly reduced to crowns and all internodes concealed by imbricated stipules, sometimes a little developed and up to 3 cm. long, then prostrate and radiating; *stipules* submembranous, or pallid and rather firm, becoming papery and brownish in age, acutely ovate, triangular, or lanceolate, 3–7 mm. long, decurrent around $\frac{1}{2}$ – $\frac{2}{3}$ the stem, dorsally pubescent with white or mixed black and white hairs; *leaves* (1.5) 2.5–10 cm. long, with petiole mostly as long as the rachis, and 7–13 (or in some early leaves 1–3) obovate-cuneate or elliptic-oblanceolate, obtuse or subacute, flat or loosely folded leaflets 3–12 mm. long; *peduncles* subradical, 0.5–3 (5) cm. long, much shorter

than the leaves, ascending at anthesis, arcuate-procumbent in fruit; *racemes* shortly but loosely, sometimes subcapitately 2–10-flowered, the axis 1–15 mm. long in fruit; *bracts* rather firmly membranous, becoming papery, ovate or lance-acuminate, 1.5–5.5 mm. long; *pedicels* ascending or a trifle arched outward, at anthesis slender, scarcely thickened in fruit; *bracteoles* 0, rarely 2, exceptionally conspicuous; *calyx* 6–10.5 mm. long, white- or partly black-pubescent, the subsymmetric, campanulate or turbinate disc (0.8) 1–1.4 mm. deep, the tube cylindric or vase-shaped, the subulate teeth 1.3–2.5 mm. long; *petals* whitish or dirty white with faintly maculate keel-tip, or all $\pm$ suffused with pale purple; *banner* recurved through $\pm 40^\circ$, broadly rhombic- or spatulate-oblongate, shallowly notched, 11–18.5 mm. long, 5.5–8 mm. wide; *wings* slightly shorter, the narrowly lance-oblong or oblanceolate, obtuse or erose-emarginate, nearly straight blades 6–9.3 mm. long, 1.7–2.6 mm. wide; *keel* 8.3–14.3 mm. long, the half-obovate blades 3.7–6.2 mm. long, 2–3.2 mm. wide, rather abruptly incurved through $85\text{--}95^\circ$ to the bluntly deltoid apex; *pod* ascending (humistrate), obliquely ovoid, lance-ovoid, or lunately ellipsoid, 9–20 (22) mm. long, 4–8 mm. in diameter, obcompressed toward the base, passing upward into a laterally compressed beak, carinate ventrally by the prominent, thick suture, the fleshy, green or purplish, densely strigulose valves becoming leathery, brownish or stramineous beneath the vesture, nearly smooth or finely rugulose-reticulate, not inflexed; *dehiscence* apical, after falling; *ovules* 18–33; *seeds* brown or soot-black, smooth or variously pitted, 1.7–2.5 mm. long.

Since the flowers of the chestnut milk-vetch are small, whitish, or suffused with dingy lavender and the humistrate pods ordinarily concealed beneath the tufted foliage, it is one of the least showy *Argophylli*. It has no very close relative among the *Missourienses* and might be described as a small-flowered version of *A. argophyllus* var. *Martini* in which the hairs of the herbage have become laterally affixed. The species has differentiated out into two geographic races.

Key to the Varieties of *A. castaneiformis*

1. Pod variable in outline, but the body contracted only well above the middle into a short, compressed-conical beak; *flowers* relatively long, the calyx (7.5) 9–10.5 mm., its tube (6.3) 6.7–8 mm. long, 2.6–3.4 mm. in diameter, the banner (14.5) 15–18.5 mm. long; *vesture* of the herbage commonly silky and lustrous, that of the stipules no more dense than that of the leaves; Arizona 220a. var. *castaneiformis*
1. Pod contracted at or near the middle into a prominent, broadly deltoid beak nearly as long or slightly longer than the obcompressed body; *flowers* shorter, the calyx 6–8.9 mm., its tube 4.7–6.8 mm. long, 2.3–2.6 mm. in diameter, the banner 11–15.5 mm. long; *vesture* of the herbage coarser and duller, but the stipules densely and permanently gray-pubescent; Utah 220b. var. *consobrinus*

220a. *ASTRAGALUS CASTANEIFORMIS* var. *CASTANEIFORMIS*

Habit of the species, the older plants usually developing a well-defined caudex; *racemes* 5–10-flowered, the axis 5–15 mm. long in fruit; *pedicels* at anthesis 1.8–2.8 mm., in fruit 2.2–3.5 mm. long; *calyx* usually exactly cylindric; *petals* commonly purplish, all but the keel-tip often drying ochroleucous; *wings* (13) 14.5–18.2 mm. long, the claws 6.9–9.3 mm.; *keel* 11.5–14.3 mm. long, the claws 7.3–8.9 mm. long; *anthers* (0.55) 0.6–0.8 mm. long; *pod* varying from plumply half-ovoid, with straight ventral and strongly convex dorsal sutures, to lunately ellipsoid with concave ventral suture, and from nearly as broad to less than half as broad as long.—Collections: 27 (v); representative: *MacDougal* 66 (GH, NY, PH, POM); *Eastwood & Howell* 972, 1105 (CAS); *Barneby* 12,631 (RSA).

Gentle slopes and flats in yellow pine forest, descending more rarely into oak woodland, in dry stony soils of basaltic or rarely calcareous origin, (5900) 6500–8000 feet, rather frequent on the Kaibab and Mogollon Plateaus in Coconino

County and extending feebly southeast to the Natanes Plateau in Gila County, Arizona.—Map No. 90.—May to early July.

ASTRAGALUS CASTANEIFORMIS (chestnut-shaped, of the pod) Wats. in Proc. Amer. Acad. 20: 361. 1885 ("*castaneaeformis*").—"Near Williams' Station, Arizona, by Mr. & Mrs. J. G. Lemmon, July, 1884."—Holotypus, *Lemmon 3262*, GH! isotypi, P, US!—*A. argophyllus* var. *castaneiformis* (Wats.) Jones, Contrib. West. Bot. 10: 62, Pl. 15. 1902 ("*castanaeformis*"). *Xylophacos castaneiformis* (Wats.) Rydb. in Bull. Torr. Club 52: 155. 1925. *A. castaneiformis* var. *typicus* Barneby in Amer. Midl. Nat. 41: 497. 1949.

The pod of var. *castaneiformis*, as particularly noted by Kearney & Peebles (1951, p. 459), varies greatly in outline and degree of inward curvature, but the variants are not fully correlated with dispersal patterns. A plump chestnut-shaped fruit, sometimes hardly longer than wide, is most common south of the Grand Canyon, whereas a narrower incurved one seems to be prevalent on the Kaibab Plateau. Forms intermediate between the extremes are common, especially about the San Francisco Peaks.

The chestnut milk-vetch was collected first in February, 1854, on Bill Williams Fork, in Yavapai County, by Bigelow on the Whipple Expedition (NY).

220b. *ASTRAGALUS CASTANEIFORMIS* var. *CONSOBRINUS*

Usually very dwarf and condensed, without perceptible caudex, sometimes flowering the first season; *racemes* 2–7-flowered, the axis 1–10 mm. long in fruit; *pedicels* at anthesis 1.2–1.5 mm., in fruit 2–2.3 mm. long; *calyx* usually tapering toward the base, narrowly vase-shaped; *petals* white or whitish except for the pinkish keel-tip, turning ochroleucous when dry; *wings* 10.1–14.7 mm., the claws 4.8–7 (7.5) mm. long; *keel* 8.3–12 mm., the claws 5–7.6 mm. long; *anthers* 0.5–0.65 mm. long; *pod* obliquely ovoid or lance-ovoid, either nearly straight or gently incurved. Collections: 7 (v); representative: *Ripley & Barneby 4749*, 8536 (RSA), 8600 (CAS, NY, RSA); *Cronquist 9367* (NY).

Open gravelly or sandy knolls, barren stony hillsides, and cobblestone bluffs, in alluvial soils of varied composition, but only rarely on basalt, sometimes in yellow pine forest, 6000–8000 feet, apparently not common but sometimes locally plentiful on both slopes of the Colorado-Sevier watershed in eastern Sevier, western Wayne, Piute, and western Garfield Counties, Utah.—Map No. 90.—May to June. June.

ASTRAGALUS CASTANEIFORMIS var. *CONSOBRINUS* (cousin-german) Barneby in Amer. Midl. Nat. 41: 496. 1949.—"UTAH . . . southeast of Bicknell, Wayne Co., alt. 7600 ft., 10 June, 1947, fl. & fr., *Ripley & Barneby No. 8605*."—Holotypus, CAS! isotypi, GH, NY, RM, RSA, UTC!

The var. *consobrinus* is an inconspicuous little plant, sometimes flowering precociously as a leafy tuft only 3–4 cm. across, but eventually developing a woody caudex. It coincides in range with forms of *A. argophyllus* but may be distinguished by the hair-attachment and by the flower's small size.

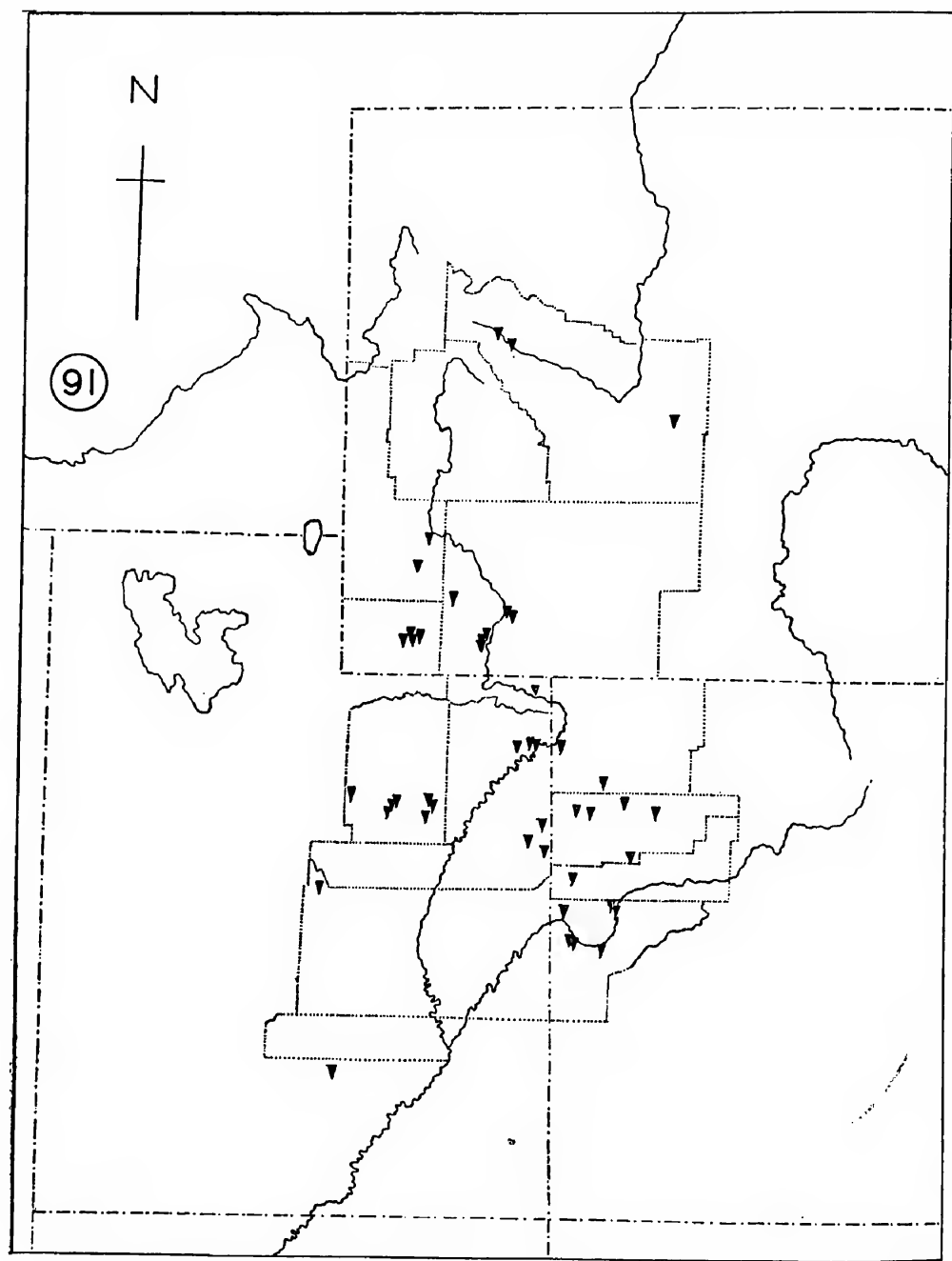
221. *ASTRAGALUS CHAMAELEUCE*

Low, tufted, acaulescent or very shortly caulescent, sometimes flowering the first season but ultimately forming a shortly forked caudex, densely strigulose throughout or nearly so with rather coarse, straight or nearly straight, appressed or some narrowly ascending hairs up to 0.7–1.15 mm. long, the herbage cinereous or canescent, the vesture of the upper surface of the leaflets often assuming a golden-green hue when dried; *stems* few or several, either reduced to sessile crowns or slightly developed and up to 3 (6) cm. long, then prostrate, the internodes not over twice as long as the stipules, mostly shorter; *stipules* submembranous becoming papery, ovate-triangular or triangular-acuminate, 2–7 mm. long, semiamplexicaul-decurrent; *leaves* 2–8 (11) cm. long, with rather firm but almost always deciduous petiole and (1) 5–15 (17) broadly obovate, obovate-cuneate, or rarely oblanceolate, mostly obtuse or truncate-emarginate, exceptionally rhombic-oval

and subacute, flat, rather thick-textured leaflets (2) 4–13 (15) mm. long, those of the lower leaves (especially of seedling plants) often fewer and larger than those of later ones, sometimes solitary; *peduncles* rather stout, (1) 2–6 cm. long, shorter than the leaves, incurved-ascending at anthesis, arcuate-procumbent in fruit; *racemes* shortly or subumbellately (2) 4–11-flowered, the flowers spreading or ascending, the axis little elongating, (0.3) 1–2 cm. long in fruit; *bracts* papery-membranous or early becoming so, ovate-triangular to broadly lanceolate, 2–5 mm. long; *pedicels* at anthesis ascending, straight, 1–2 mm. long, in fruit either ascending or arched outward, 1.8–3.5 mm. long; *bracteoles* usually 0, rarely 1–2, minute; *calyx* 9.1–12.4 (13.5) mm. long, strigulose with black, black and white, or all white hairs, the slightly oblique disc 0.9–2 mm. deep, the submembranous, purplish, cylindric or exceptionally deep campanulate tube 6.7–9.5 (12) mm. long, 3.2–4.5 mm. in diameter, the subulate teeth 1.4–2.9 mm. long; *petals* either ochroleucous with dull purple keel-tip, or ochroleucous tinged with lurid purple, or bright pink-purple except for pale claws and pale lozenge in the fold of the banner; *banner* recurved through $\pm 45^\circ$, broadly oblanceolate, rhombic-oblanceolate, or obovate-spatulate, shallowly notched, 17–24 (25.5) mm. long, 8.2–12 mm. wide; *wings* a little shorter or rarely as long, 16.6–22.4 mm. long, the claws 8.1–12 mm., the narrowly lance-oblong, obtuse or obliquely emarginate blades 9.3–12 mm. long, 2.2–3 mm. wide, commonly a little incurved in the distal $\frac{1}{2}$; *keel* 14.6–20 (22) mm. long, the claws 8.1–12.7 (13.3) mm., the lunately half-oval or -obovate blades 6.5–8 (9) mm. long, 2.9–3.7 mm. wide, incurved through $85\text{--}95^\circ$ to the rounded apex; *anthers* 0.5–0.7 (0.75) mm. long; *pod* ascending (humistrate), obliquely oblong-ovoid or -ellipsoid, (2) 2.5–4 cm. long, (7) 9–16 mm. in diameter, rounded at base, a little dorsiventrally compressed and shallowly sulcate ventrally in the lower $\frac{1}{2}$ – $\frac{2}{3}$, thence passing upward, gradually or abruptly, into a short, obconic or deltoid, laterally compressed, shortly cuspidate beak, slightly but definitely incurved, the fleshy valves ± 3 mm. thick when fully formed, shrinking somewhat in ripening, composed of a leathery endocarp and a fragile, papery exocarp separated by a layer of dry, spongy-alveolate tissue, the outermost skin at first greenish and commonly purple-mottled and -speckled, densely strigulose or rarely glabrous, transversely reticulate, ultimately becoming stramineous, lustrous, separating from the veins beneath, then appearing quite smooth; *dehiscence* apical, after falling; *ovules* 38–60; *seeds* pale pinkish- or ochre-brown, pitted and rugulose, 2.4–3 mm. long.—Collections: 46 (xvi); representative: *Ripley & Barneby 8911* (CAS, RSA, UTC); *A. Nelson 4605* (GH, NY, RM); *Jones* (from Theodore, Utah), *May 12, 14, 19, 1908* (POM); *W. A. Weber 3350* (CAS, TEX, WS), *3782* (TEX, WS); *C. L. Porter 3631, 3681* (RM, TEX).

Dry open bluffs, gullied hillsides, knolls, and canyon benches, in gravelly or sandy, often alkaline clay soils derived mostly from shale or sandstone, sometimes in coarse alluvia of cobblestone bluffs, rarely in broken lava, 4750–7000 (8350) feet, rather common and locally plentiful in the Colorado and Green River Basins, from the foot of the Henry Mountains in eastern Garfield County, Utah, north through northwestern Colorado and the Uinta Basin to southwestern Wyoming; extending less commonly across the Continental Divide to the upper Wind and Big Horn Rivers in westcentral Wyoming.—Map No. 91.—Late April to June, into July northward.

ASTRAGALUS CHAMAELEUCE (a fanciful, substantival epithet, from *chamae*, on the ground, and *leuke*, white poplar) Gray in Ives, Rep. Colo. River, Bot. 10, quoad nom. 1860, based on *Phaca pygmaea* (dwarf) Nutt. ex. T. & G., Fl. N. Amer. 1: 349. 1838.—“Rocky Mountains, on the hills of Ham’s Fork of the Colorado of the West . . . Nuttall.”—Holotypus, labeled by Nuttall “*Phaca pygmaea*. R. Mts.” BM! isotypus, NY!—*Tragacantha pygmaea* (Nutt.) O.



Map No. 91. Utah and parts of Wyoming and Colorado. Range of *A. chamaeleuce*.

Kze., Rev. Gen. 941. 1891. *Xylophacos pygmaeus* (Nutt.) Rydb. in Bull. Torr. Club 32: 662. 1905. *Astragalus pygmaeus* (Nutt.) Jones, Rev. Astrag. 210. 1923; non Pall., 1800.

Astragalus cicadae (of the cicada, the membranous outer skin of the ripe pod resembling a locust wing) Jones in Zöe 4: 35. 1893.—"Grand Junction, Colo. ["along the railroad track which goes to the coal mine" acc. Eastw. in Zöe 4: 16], May, 1892. Collected by Miss Alice Eastwood."—Holotypus, Eastwood 10, in 1892, POM! isotypi, CAS, GH, MINN, MO, ND, US!—*A. Chamaeleuce* var. *cicadae* (Jones) Jones, Contrib. West. Bot. 8: 12. 1898. *A. pygmaeus* var. *cicadae* (Jones) Jones, Rev. Astrag. 211. 1923.

Astragalus cicadae var. *laccoliticus* (of a laccolith, the plant found in volcanic gravel) Jones in Proc. Calif. Acad. Sci. II, 7: 672. 1895.—“No. 5658q. July 21, 1894, at Cottrell's Ranch, Henry Mountains, Utah, 6000° alt.”—Holotypus, POM!—*A. pygmaeus* var. *laccoliticus* (Jones) Jones, Rev. Astrag. 211. 1923. *A. Chamaeleuce* var. *laccoliticus* “Jones” ex Rydb. in N. Amer. Fl. 24: 300, in syn. (errore). 1929.

The cicada milk-vetch, in the Uinta Basin called “Popper” from the crackle of the ripe pods underfoot, is the only astragalus of its type known to occur in Utah north of Tavaputs Escarpment or in western Wyoming. On the lower Grand River in Colorado it is sympatric and sometimes closely associated with *A. amphioxys* var. *vespertinus*; south of the Escarpment in Utah (where it seems to be extremely rare) its range overlaps those of *A. amphioxys* var. *amphioxys* and *A. cymboides*. Flowering plants of these species are identified with difficulty. Fortunately the extremely distinct fruits ripen early, for they are often necessary in determining the correct name. The ripe pod of *A. Chamaeleuce* is remarkable for the textural differentiation of the three layers of cellular tissue of which the valve walls are composed. The thick mesocarp is made up of unusually large cells at first laden with a sweetish sap, which is gradually withdrawn as the seeds ripen, leaving a fragile honeycomb of pith. Consequently, the ripe fruit is so light in relation to its mass that it may be dispersed readily by the wind. The thin, reticulately veined outer skin, which ripens to a papery-membranous texture, suggests the glassy transparency of a locust's wing.

The named varieties of the cicada milk-vetch were based on individual variations and have no claim to taxonomic rank. At the time Jones described *A. cicadae* he was ignorant of the true nature of *A. Chamaeleuce*, for he compared his new species only with *A. amphioxys* and the distantly related *A. megacarpus*. Subsequently (1923, p. 211) he applied the trinomial *A. pygmaeus* var. *cicadae* to the material of *A. chamaeleuce* from the Uinta Basin southward, but he advanced no effective differential characters distinguishing it from the typical form. Nearly all examples of the cicada milk-vetch from north of the Uinta Mountains have 50–60 ovules as opposed to 37–46 southward, which suggests incipient racial differentiation; but no other consistent difference is apparent. The var. *laccoliticus* was described by Jones (1923, p. 211) as suggesting a hybrid between *A. chamaeleuce* and *A. musiniensis*, on account of its subacute leaflets and rather strongly incurved pod. However neither of the supposed parents was found by Jones in the Henry Mountains, and a hybrid hypothesis seems superfluous to account for the hardly unusual appearance of the type-collection. As the Henry Mountains are remote from the main range of *A. chamaeleuce*, the habitat on “volcanic gravel” is strange for the species. Fresh young material from this region collected earlier in the year is required.

222. ASTRAGALUS AMPHIOXYS

Low, tufted, or loosely matted, subcaulescent or shortly caulescent, winter-annual or perennial of short duration, densely strigose-strigulose throughout with stiff, straight, appressed, usually subcontiguous (and on some peduncles and petioles a few narrowly ascending), sometimes mixed with shorter, sinuous hairs up to 0.65–1.25 (1.5) mm. long, the herbage silvery-white or rarely greenish, the leaflets equally pubescent on both sides, the inflorescence sometimes black-hairy; *stems* usually several, prostrate or weakly ascending, in seedlings sometimes solitary and erect, 1–7 (exceptionally, in shade, up to 15) cm. long, the internodes often concealed by stipules, but as commonly developed and up to 2 (4.5) cm. long but mostly less; *stipules* (1.5) 2.5–10 (13) mm. long, submembranous becoming papery in age, ovate, deltoid, triangular, triangular-acuminate or -caudate, semi- (the lowest sometimes fully) amplexicaul; *leaves* 2–10 (13) cm. long, all petioled, with (7) 11–21, or in some seedlings only (1) 3–7, elliptic, rhombic-elliptic, oblanceolate, or obovate, sharply acute to obtuse and mucronulate, exceptionally emarginate, distant or crowded, flat or loosely folded leaflets 3–13 (20) mm. long; *peduncles* ascending at anthesis, arcuate-recurved or prostrate in fruit, (1) 2.5–14 (20) cm. long, a little longer or shorter than the leaf; *racemes* loosely but often quite shortly (2) 4–10 (13)-flowered, the flowers ascending, the axis (0.5) 1–4.5 (6.5) cm. long in fruit; *bracts* submembranous becoming papery-scarious, narrowly ovate to lanceolate or lance-acuminate, 2.5–8 mm. long; *pedicels* ascending or arched outward in age, at anthesis slender, 0.6–1.8 mm., in fruit thickened, 1.2–2.5 mm. long; *bracteoles* 0–2; *calyx* 6.3–14.2 mm. long,

pubescent like the herbage with white, mixed black and white, or all black hairs, the slightly oblique disc 1.2–2.7 (3) mm. deep, the cylindric or cylindro-campanulate, purplish tube 5.2–10.5 mm., the subulate teeth 1.1–3.7 (4.5) mm. long; *petals* bright pink-purple, the banner with a large striate lozenge in the fold, exceptionally pure white; *banner* recurved through $\pm 40^\circ$, oblanceolate, rhombic-oblanceolate, or spatulate, shallowly or deeply notched, 12.8–27 (28) mm. long; *wings* a little shorter, the blades linear- or narrowly lance-oblong, usually a trifle dilated above the claw, the distal half a little narrower and either straight or incurved, obtuse; *keel* 11–22.4 mm. long, the half-obovate or obliquely triangular-obovate blades rather abruptly incurved through $85\text{--}95^\circ$ to the rounded apex; *anthers* 0.5–0.85 (0.9) mm. long; *pod* ascending (humistrate), variable in length and curvature, (1.5) 2–4 (5) cm. long, 5–10 mm. in diameter, most commonly 1) *crescentic* in profile, gently and evenly arched through $\frac{1}{4}$ –1 circle, laterally compressed and acute to long-acuminate at both ends, obcompressed at the middle; or 2) *straight*, but otherwise as above; or 3) *obcompressed* throughout below the beak; or 4) when *short*, then obtuse and dorsiventrally compressed at base, acuminate and laterally compressed distally; in all cases both sutures prominent their whole length, the dorsal one often sinuous, commonly depressed at the middle of the pod and lying in a double groove, the green or sometimes mottled, $\pm$ fleshy, strigulose valves becoming stiffly leathery or subligneous, rarely a trifle spongy in age, reticulate and sometimes also wrinkled lengthwise, often rugulose on the obtuse, transversely dilated angles, either not inflexed or if so the septum present only near the middle of the pod and very narrow, not over 1.1 mm. wide; *dehiscence* apical, through the gaping beak, and also basal, through the dorsal or both sutures; *ovules* (42) 44–70; *seeds* brown, variably pitted or wrinkled, sometimes lustrous, 2–2.9 mm. long.

The crescent milk-vetch, *A. amphioxys*, is a perplexingly polymorphic species. The pod is highly variable in length, degree of curvature, and compression, although the mode of compression is determined to large degree by the other two. The species is adapted to desert or near-desert climates and the populations fluctuate greatly in number and vigor in response to bountiful or meager spring rainfall. The plants are potentially perennial but relatively short-lived, often bearing flowers and fruits precociously, and sometimes perishing after the first or second summer. A favorable season after a period of several years drought, during which the older plants have died out, may bring out a swarm of floriferous seedlings easily mistaken for annuals. In the Rio Grande Valley, where summer rainfall prevails, the crescent milk-vetch can often be found in flower from late June or July onward, although elsewhere it is essentially a member of the early spring flora.

The flower of *A. amphioxys* is variable in length, both absolutely and in relative proportion of the calyx and petals. This type of variation is correlated with dispersal, permitting the segregation of three poorly differentiated and partly overlapping varieties.

Key to the Varieties of *A. amphioxys*

1. Flowers large, the calyx 9.3–14 mm., the banner (16.4) 19–28 mm., the keel (13.2) 14.3–23.7 mm. long; range of the species (2)
2. Flower variable in size, but the banner less than twice or barely twice the length of the calyx; *keel* (13.2) 14.3–18.8 mm. long; range of the species except s.-w. Colorado (if led hither by material from s.-w. Colorado or s.-e. Utah, cf. *A. missouriensis* var. *amphibolus*) 222a. var. *amphioxys*
2. Flower always large, the banner 2–2½ times the length of the calyx; *keel* 19–23.6 mm. long; s.-e. Utah, s.-w. Colorado, and extreme n. Arizona 222c. var. *vespertinus*
1. Flower small, the calyx 6.3–9.3 mm., the banner 12.8–16 mm., the keel 11–12.7 mm. long; s. Nevada and adjoining Arizona n. of Grand Canyon 222b. var. *modestus*

222a. *ASTRAGALUS AMPHIOXYS* var. *AMPHIOXYS*

Calyx-tube (5.8) 7–10.5 mm. long, 3.2–4.2 (4.7) mm. in diameter, the teeth 1.5–3.7 (4.5) mm. long; *banner* (16.2) 19–24.5 mm. long, 8.2–12.2 mm. wide; *wings* (15.1) 18–22.4 mm. long, the claws (7.1) 8–11.5 mm., the blades (8.3)

9.5–11.5 mm. long, 2.4–4.2 mm. wide; *keel* (13.2) 14.3–18.8 (19.6) mm. long, the claws 6.5–11.8 mm., the blades 6.8–9.8 mm. long, 2.9–3.8 mm. wide; *pod* as described for the whole species; *ovules* (42) 44–56 (68), averaging $\pm$ 50. Collections: 75 (xx); representative: *Fendler* 149 (GH); *Ripley & Barneby* 11,164 (CAS, RSA); *Peebles & Parker* 14,634 (GH, POM); *Cutler* 4641 (GH, NY, WS); *Parry* 46, 49 (GH, NY, POM); *C. L. Porter* 1774 (WS, WTU); *Ripley & Barneby* 3345 (CAS, RSA).

Sandy valleys, plains, gravelly hillsides, sometimes on dunes, rarely on gumbo-clay flats, without apparent rock preference (except locally), 1600–6100 feet, widespread and locally plentiful from southern Nevada and southern Utah east across Arizona north of the Mogollon Escarpment into central New Mexico, south along the Rio Grande into extreme western Texas and adjoining Chihuahua. —Map No. 92.—Late March to June, and eastward again after summer or fall rains.

ASTRAGALUS AMPHIOXYIS (sharp at both ends, of the pod) Gray in Proc. Amer. Acad. 13: 366. 1878.—“Southern Utah and New Mexico and Northern Arizona, Thurber, Parry, Palmer, etc. . . .”—Lectotypus (Rydb., 1925, p. 148): Doña Ana, New Mexico, *Thurber* 295, GH!—*A. Shortianus* var. (?) *minor* (smaller) Gray in Proc. Amer. Acad. 6: 211. 1864. *Xylophacos amphioxys* (Gray) Rydb. in Bull. Torr. Club 32: 662. 1905 (“*amphioxus*”). *A. amphioxys* var. *typicus* Barneby in Amer. Midl. Nat. 37: 437. 1947.

Astragalus crescenticarpus (with crescentic pod) Sheld. in Minn. Bot. Stud. 1: 148. 1894. —“Collected on sandy plains north of sulphur springs, New Mexico, June, 1883, by G. R. Vasey, and near Winslow, Arizona, June, 1892, by Professor E. O. Wooton.”—Holotypus, labeled “El Paso, 1881, Vasey,” annotated by Sheldon, MINN! paratypus, *Wooton*, MINN!—*A. selenaeus* (of the moon, meaning crescentic) Greene in Erythea 3: 76. 1895, a superfluous substitute.

Xylophacos aragalloides (resembling *Aragallus* or *Oxytropis* sp.) Rydb. in Bull. Torr. Club 34: 48. 1907.—“UTAH: St. George, 1880, *M. E. Jones* 1633 (type in herb. Columbia Univ.); 1877, Dr. *E. Palmer* 101.—Holotypus, NY! isotypi, GH, PH, POM! paratypi, *Palmer*, GH, NY!

Astragalus amphioxys $\times$ *Layneae* Jones, Rev. Astrag. 215. 1923, as to material cited, not description.—The full synonymy of this proposition is cited under *A. Tidestromii*.

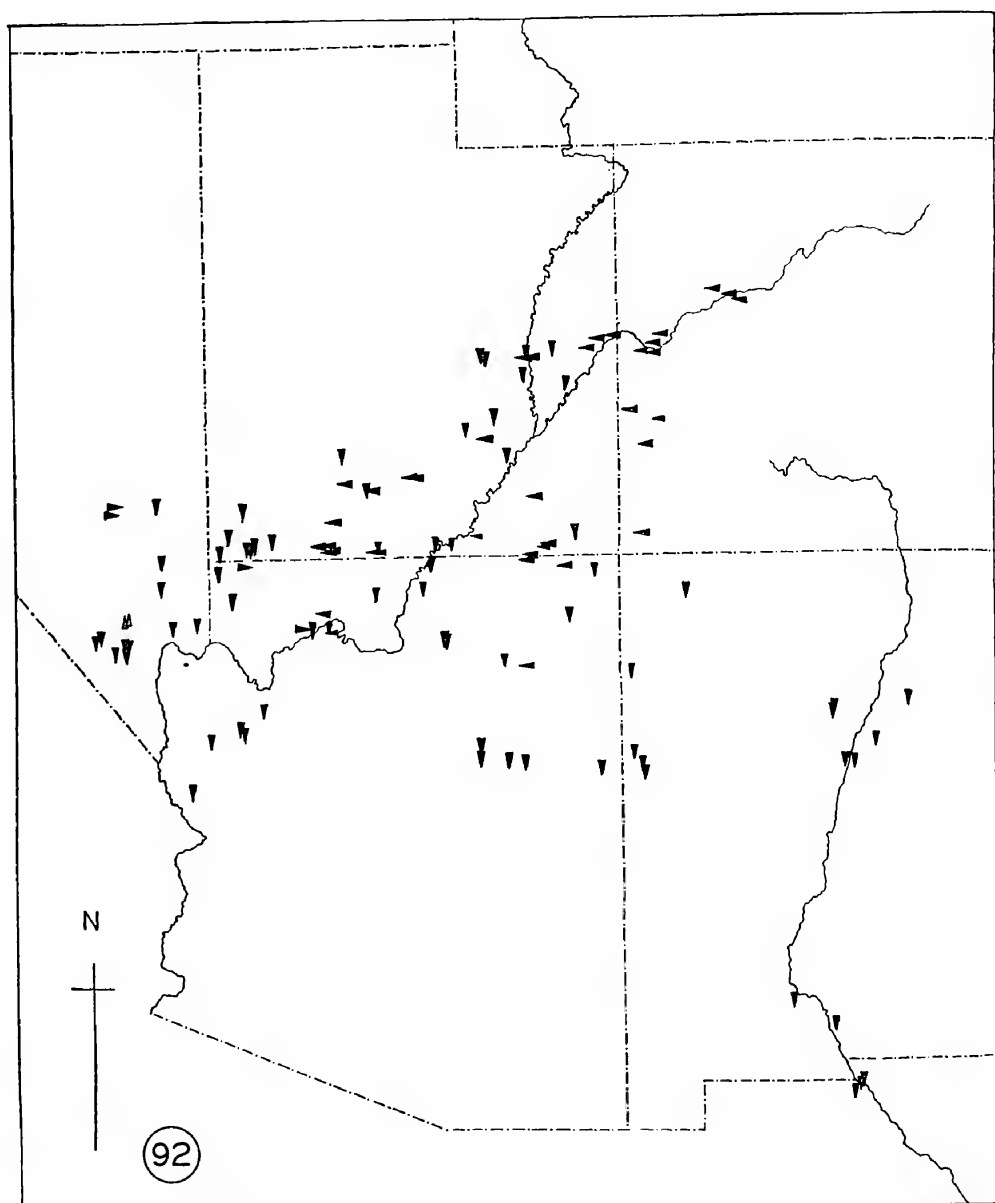
Xylophacos melanocalyx (with black-hairy calyx) Rydb. in Bull. Torr. Club 52: 149. 1925.—“Type collected at Copper Mine west of St. George, Utah, April 4, 1894, *Jones* 5009 . . .”—Holotypus, POM! isotypus, US!—*A. amphioxys* var. *melanocalyx* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 68: 40. 1935. *A. Marcus-Jonesii* (Marcus Eugene Jones, 1852–1934) Munz in Leaf. West. Bot. 3: 50. 1941, a legitimate substitute (non *A. melanocalyx* Bss., 1860).

The var. *amphioxys* corresponds with var. *typicus* Barneby (1947, l.c.), modified by exclusion of some small-flowered plants now referred to var. *modestus*. The taxonomic history, synonymy, and morphological variation were discussed at length in the preliminary revision (1947, p. 438–440), and I comment here briefly on the polymorphic fruit and present a census of the more striking minor variants.

The pod of var. *amphioxys* varies from 1.5 to 5 cm. in length, although extremes outside a range of 2–4 cm. are uncommon. The absolute length appears to be the critical factor governing the degree of curvature, while this in turn largely determines the degree of dorsiventral compression at and near the middle. A long pod tends to become strongly incurved or coiled into a ring, is narrowly transverse-oblong in median section, and is laterally compressed at both ends. A pod of moderate size is ordinarily crescentic in profile, obcordate in median section, and shortly compressed at either end. The shortest type of pod tends to be little incurved, and the lateral compression of the basal segment may become obscure or obsolete. However, nearly straight pods of medium and great length are encountered occasionally. Generally speaking, the pod becomes thicker-textured, and hence more strongly rugulose on the lateral angles, toward the northwest edge of the species-range, especially north of the Grand Canyon. On the other hand, a brightly mottled pod, of sporadic occurrence throughout the range, is observed most frequently to the southeast.

The following minor variants deserve mention:

M. v. 1. Densely white-pubescent throughout; *leaflets* small, elliptic, subacute; *pod* relatively thin-walled, $\pm$ 5–7 mm. in diameter; range of the species, rare n. of the Colorado River (*A. amphioxys*, sens. str.).



Map No. 92. Utah, Arizona, and parts of adjoining states. Range of *A. amphioxys*: var. *amphioxys*; var. *vespertinus*; and var. *modestus*; and of *A. musimonum*.

M. v. 2. Robust; calyx commonly black-pubescent; leaflets averaging larger, variable in outline; pod more fleshy, becoming strongly rugulose on the angles, $\pm 7-10$ mm. in diameter; n.-w. Arizona and adjoining Utah and Nevada (*Xylophacos melanocalyx*; *A. amphioxys* $\times$ *Layneae* in part, as to material cited).

M. v. 3. Thinly strigulose, the herbage green; stems sometimes strongly developed; within the range of the last, an occasional shade form.

M. v. 4. Densely and finely silky-strigose throughout; leaflets narrowly elliptic, acute; calyx-teeth sometimes elongate; s.-w. Utah and s. Nevada, a dune ecotype (*Xylophacos aragaloides*).

M. v. 5. Strongly perennial, with woody root and caudex; foliage, calyx, and pod all very densely and shortly white-strigose; near Las Vegas, Nevada, a locally abundant ecotype of alkaline clay flats.

M. v. 6. Low, slender, often appearing annual; *pod* short, $\pm$ 1.5–2 cm. long, little incurved, cuneate rather than acuminate at base; n. Arizona, a vernal or starveling form sometimes associated with M. v. 1 (*Xylophacos brachylobus* sensu Rydb. as to the supposed *typus*, Palmer 102, in 1877, but excluding the basionym *A. Shortianus* var. *brachylobus* Gray = *A. tephrodes* var. *brachylobus* (Gray) Barneby, q. v. for fuller synonymy).

The range of *A. amphioxys* closely approaches the California state line, and the species is to be sought in the eastern Mohave Desert. However a specimen labeled "Mohave River District, s.-e. California" (Palmer 105 in 1876, NY ex herb. Canby.) needs confirmation.

222b. ASTRAGALUS AMPHIOXYS var. MODESTUS

Habit of var. *amphioxys*, but the flowers smaller; *calyx-tube* 6.1–9.3 mm. long, 2.3–3.3 mm. in diameter, the teeth 1.1–2.6 mm. long; *banner* 12.8–16 mm. long, 5.8–8 mm. wide; *wings* 12–15 mm. long, the claws 6–7.4 mm., the blades 6.7–8.5 mm. long, 1.9–2.5 mm. wide; *keel* 11–12.7 mm. long, the claws 6.2–7.5 mm., the blades 5.4–6.3 mm. long, 2.3–2.7 mm. wide; *pod* 3–4 cm. long, crescentic or incurved through $\frac{1}{2}$ -circle; *ovules* 44–58.—Collections: 4 (iii); representative: Ripley & Barneby 3474, 4404 (RSA).

Dry gravelly hillsides, sometimes among sagebrush, on limestone or in cindery volcanic debris, 4200–4550 feet, local, forming uniform colonies within the range of var. *amphioxys* but known only from valleys affluent to the Colorado River from the north in Lincoln County, Nevada, and northern Mohave County, Arizona.—Map. No. 92.—March to May.

ASTRAGALUS AMPHIOXYS var. MODESTUS (unassuming) Barneby in Leaflet. West. Bot. 9: 89. 1960.—"ARIZONA: e. side of Vulcan's Throne, Toroweap Valley, Grand Canyon National Monument, Mohave County, about 4500 ft., April 23, 1952, Elizabeth McClintock 52–193."—Holotypus, CAS! isotypi, ARIZ, NY, RSA!

If we follow tradition by maintaining a var. *vespertinus* to accommodate the large-flowered race of *A. amphioxys* endemic to the Colorado Basin, it seems illogical to overlook the opposite extreme in flower-size which is found in a limited area of southern Nevada and adjoining Arizona. Neither of these varieties differs consistently from var. *amphioxys* in any feature of the pod. While var. *vespertinus* is dispersed partly within and partly to the northeast of the typical variety, the range of var. *modestus* lies entirely within that of var. *amphioxys* and seems that much more open to criticism. It may possibly consist of no more than an arbitrary selection of small-flowered populations. It should be noted, however, that var. *amphioxys* seems that much more open to criticism. It may possibly consist of no more than an arbitrary selection of small-flowered populations. It should be noted, however, that var. *amphioxys* reaches its greatest known flower-size in southern Nevada, and it is necessary to turn to Arizona south of the Colorado or to New Mexico to find specimens approaching var. *modestus* in length of petals and calyx. There is some evidence that var. *modestus* occurs at somewhat greater elevations than var. *amphioxys* in their common area.

222c. ASTRAGALUS AMPHIOXYS var. VESPERTINUS

Habit of var. *amphioxys*, but the flowers a little larger, and the petals less strongly graduated; *calyx-tube* 8.8–13.2 mm. long, 3.8–5.2 mm. in diameter, the teeth 1.3–3 mm. long; *banner* 23–27 (28) mm. long, 7.8–12.7 mm. wide; *wings* 21.5–25 (26) mm. long, the claws 9.8–13.4 mm., the blades 12.2–16.3 mm. long, 2.5–4.2 mm. wide; *keel* 19–23.6 mm. long, the claws 10.2–13.4 mm., the blades 8.6–12.2 mm. long, 3.2–4.4 mm. wide; *pod* $\pm$ 3–3.5 cm. long, gently incurved; *ovules* 50–70 (averaging $\pm$ 60).—Collections: 28 (vi); representative: Ripley & Barneby 8577 (RSA, UTC); Barneby 12,751 (CAS, RSA); Jones 24,430 (CAS, POM); W. A. Weber 3335 (CAS, TEX); J. T. Howell 24,729 (CAS, RSA); Holmgren 3250 (NY, WS, WTU).

Sandy valley floors, ledges under cliffs, and gravelly hillsides, in sagebrush or juniper forest, mostly on sandstone, 4300–5900 (6300) feet, locally plentiful within the Colorado Basin, south of Tavaputs Escarpment, southwestern Colorado and southeastern Utah, extending feebly west to the Grand Canyon and Kanab Plateau in northwestern Arizona.—Map No. 92.—April to June.

ASTRAGALUS AMPHIOXYIS var. *VEPERTINUS* (Sheld.) Jones, Rev. Astrag. 215. 1923, based on *A. vespertinus* (western) Sheld. in Minn. Bot. Stud. 1: 150. 1894.—“Collected near Grand Junction, Colorado, May, 1892, by Miss Alice Eastwood.”—Holotypus, *Eastwood 6109*, MINN! isotypi, MO, NY!—*Xylophacos vespertinus* (Sheld.) Rydb. in Bull. Torr. Club 32: 662. 1905.

The var. *vespertinus* is poorly characterized and flowers are required for its identification. These possess a subtly individual aspect, the petals being longer in proportion to the calyx than in var. *amphioxys* and less strongly graduated. A count of ovule-number in a random selection of 30 flowers showed a possibly significant higher average in var. *vespertinus*, although the ripe pod is no longer or larger.

Two interesting but unfortunately meager collections from the Grand Canyon (Grand View Trail, *Eastwood 5711, 5712*, CAS) were mentioned in the preliminary revision (Barneby, 1947, p. 440) as representing a variant of var. *amphioxys*, but on account of the elongate keel-petals (± 21 mm. long) are more appropriately considered under var. *vespertinus*. The plants are remarkable for their slender growth-habit, thin pubescence of hairs short for the species as a whole (up to 0.3–0.7 mm. long), few (mostly 7–9) leaflets, and long fruiting pedicels (2.7–4 mm. long). More material is needed for adequate analysis.

223. *ASTRAGALUS MUSIMONUM*

Low, tufted, subcaulescent, densely strigose-strigulose throughout with nearly straight, appressed and some few narrowly ascending hairs up to 1–1.2 mm. long, the herbage silvery-canescens; *stems* almost 0 up to 2 (7) cm. long, prostrate when developed, the internodes varying from much shorter up to twice longer than the stipules; *stipules* submembranous, triangular or lanceolate, 3–4 mm. long, $\pm$ semialexicaul; *leaves* (2) 4–7 cm. long, with slender petiole and 11–17 (19) obovate-elliptic to broadly oblanceolate, mostly acute, rather distant and scattered, flat or loosely folded leaflets 3–7 mm. long; *peduncles* (3) 4–8 cm. long, incurved-ascending at anthesis, prostrate in fruit; *racemes* shortly but loosely 5–9 (12)-flowered, the flowers becoming horizontal or a trifle declined in age, the axis little elongating, 1–2.5 cm. long in fruit; *bracts* membranous, ovate-acuminate or lanceolate, 2–3.7 mm. long; *pedicels* ascending or a trifle arched outward, at anthesis 0.5–0.8 mm., in fruit 0.6–1 mm. long, apparently disjuncting in age; *bracteoles* 0; *calyx* 5.3–6.6 mm. long, strigulose with white or some black hairs, the somewhat oblique, turbinate disc 0.8–1.1 mm. deep, the campanulate, submembranous, purplish tube 3.4–4.2 mm. long, 2.4–2.9 mm. in diameter, the subulate teeth 1.8–2.5 mm. long, the whole marcescent unruptured; *petals* pink-purple, drying bluish, the pale lozenge in the banner prominently purple-veined; *banner* recurved through $\pm 45^\circ$ (or ultimately 90°), 10.3–13.4 mm. long, the narrowly cuneate claw abruptly expanded into an oblong-obovate, deeply notched blade 6.5–9 mm. wide; *wings* 9.4–11.8 mm. long, the claws 3.2–4.1 mm., the narrowly oblong-oblanceolate or linear-oblong, subtruncate or emarginate, lunately incurved blades 7.2–8.6 mm. long, 1.8–2.5 mm. wide; *keel* (0.2 mm. shorter to 0.4 mm. longer than the wings) 9.8–11.5 mm. long, the claws 3.2–4.1 mm., the obliquely obovate or half-obovate blades 6.5–8 mm. long, 3–3.5 mm. wide, abruptly incurved through $95\text{--}100^\circ$ to the broadly rounded apex; *anthers* 0.45–0.65 mm. long; *pod* loosely spreading or incurved-ascending (humistrate), readily deciduous, narrowly and very obliquely ellipsoid, 1.5–2 (2.5) cm. long, 4–6 mm. in diameter, lunately incurved through the lower $\frac{3}{4}$ and then abruptly hamate-incurved distally, acuminate tapering and laterally compressed at both ends, cuspidate at apex, otherwise obcompressed, ventrally carinate by the gently concave suture, the convex dorsal suture also prominent but depressed at the middle and lying in a double groove, the somewhat fleshy, densely strigulose, unmottled valves becoming leathery, brownish, transversely reticulate, not inflexed; *dehiscence* apical, after falling; *seeds* unknown.—Collections: 3 (i); representative: *J. C. Allen 58* (herb. F. J. Hermann., RSA, fragm.); *Munz 16,842* (POM).

Dry hillsides in limestone gravel, $\pm$ 5300–5600 feet, locally plentiful but known only from the desertic foothills of the Sheep Mountains, in the Desert Game Refuge, Clark County, Nevada.—Map No. 92.—Late April to June.

ASTRAGALUS MUSIMONUM (of mouflons, in particular the Desert Sheep of the region) Barneby in Proc. Calif. Acad. Sci. IV, 25: 150, Pl. 17, fig. 1–9. 1944.—“NEVADA: ... Sheep Mts., near the entrance to Deadman Canyon, Clark Co. ... Ripley & Barneby 3332.”—Holotype, collected May 5, 1941, CAS! isotypus, RSA!

The Sheep Mountain milk-vetch, *A. musimonum*, is known from so few examples that an appraisal of its status as a species is perhaps premature. It now seems to me much more closely related to *A. amphioxys* than I supposed when still inexperienced in the genus and under the spell of Rydberg's system of classification. The campanulate calyx-tube and short petal claws of *A. musimonum* suggest *Batidophaca* Rydb., but this unnatural group contains no close relative. In the original description I doubtfully referred to *A. musimonum* a specimen from Mokiak Pass, Arizona (Ripley & Barneby 4321) which I now call *A. amphioxys* var. *modestus*; it is this small-flowered variety to which we must look for a clue to the origin of the present species. The chief diagnostic feature of the Sheep Mountain milk-vetch is the abrupt shortening of the calyx-tube and claws of the petals, which results in a flower not only shorter than that of var. *modestus* but also, as seen in profile, different in outline and proportions from the normal pattern in the *Argophylli*. However the discussion of *A. (Xylophacos) missouriensis* and *A. (Batidophaca) accumbens* in the following pages shows that evolution involving just such an alteration in flower-shape has occurred elsewhere in the group. If this floral modification, although multiple in effect, could be shown to have arisen from a single mutation (possibly implicating only a single gene), the gross morphological differences would lose much of their taxonomic importance, even though equivalent dissimilarities in flower form have proved most valuable in the systematics of the genus. The origin of *A. accumbens* from *A. missouriensis*, certainly by way of a small-flowered variety comparable with *A. amphioxys* var. *modestus*, seems pretty well established, for here a highly characteristic pod has remained unchanged except for size. The pod of *A. musimonum* is quite similar to that of *A. amphioxys* in most respects, especially in the lateral compression of either end, but the beak is abruptly hooked backward in a fashion unknown as yet in the commoner species. However the pod of *A. amphioxys* is subject to so great a range of variation in curvature that it would be presumptuous to assume that the terminal hook is diagnostic in the group. Further evidence from new populations of *A. musimonum* is required before the status of the species is settled.

224. *ASTRAGALUS CYMBOIDES*

Low, tufted, acaulescent or nearly so, perennial but sometimes flowering the first season, densely strigose-strigulose with straight or largely straight, appressed and (nearly always, especially on the petioles and peduncles) some looser, ascending hairs up to 0.8–1.3 mm. long, the herbage cinereous or silvery-canescens, the leaflets equally pubescent on both sides, the vestiture sometimes turning greenish-golden on the upper side when dry; *stems* 1–several, mostly reduced to sessile crowns, if elongating then prostrate, up to 2 (3) cm. long, the internodes mostly concealed by stipules, none over 5 mm. long, mostly shorter; *stipules* submembranous, becoming firmly papery, ovate, deltoid- or broadly lance-acuminate, 3–8 mm. long, semiamplexicaul; *leaves* 2.5–8 (10) cm. long, with deciduous or weakly persistent petiole and (5) 7–13 (15), or (in some early leaves, or in all leaves of seedling plants) only 1–5, obovate, elliptic, or broadly oblanceolate, obtuse or subacute, flat leaflets 3–13 (20) mm. long; *peduncles* rather stout, 2–8 cm. long, ascending at anthesis, arcuate-procumbent or prostrate in fruit; *racemes* shortly but loosely (3) 4–9 (12)-flowered, the flowers ascending, the axis little elongating, 0.5–2 (2.5) cm. long in fruit; *bracts* thinly herbaceous becoming papery, ovate- to broadly lance-acuminate, (1) 1.5–4 mm. long; *pedicels* ascending, straight or a little arched in age, at anthesis 0.7–2.3 mm., in fruit thickened, 1.3–2.5 mm. long; *bracteoles* 0; *calyx* 7.6–10.2 (14.6) mm. long, strigulose with black or mixed black and white hairs, the slightly oblique disc 1.1–1.6 (2.8) mm. deep, the cylindric or rarely cylindro-campanulate tube 5.9–8 (11) mm. long, 2.7–3.7 (4.5) mm. in diameter, the subulate teeth 1–2.3 (3.4) mm. long; *petals*

commonly whitish or yellowish, with white- or lilac-tipped wings, sometimes all suffused with dull lilac, rarely all pink-purple, the keel-tip always maculate; *banner* recurved through $\pm 40^\circ$, broadly rhombic-oblongate or spatulate, shallowly notched, 15.4–18.4 (24) mm. long, 8–10 (14.5) mm. wide; *wings* 14.7–17 (22.8) mm. long, the claws 7.6–9 (12.8) mm., the narrowly lanceolate or linear-oblong, obtuse, nearly straight blades 8.2–10 (11.5) mm. long, 2–3 mm. wide; *keel* 12.6–15.1 (20.2) mm. long, the claws 7.8–9.2 mm., the half-obovate blades 5.5–6.7 (8.8) mm. long, 2.5–3.1 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the rounded apex; *anthers* 0.6–0.8 mm. long; *pod* ascending (humistrate), narrowly oblong to oblong-elliptic in profile, straight or a trifle oblique (either suture the more convex), 1.7–3 (3.5) cm. long, 6–9.5 mm. in diameter, cuneate or rounded at base, contracted distally into a short, erect or slightly declined, triangular-cuspidate beak, fleshy and subterete when first formed, becoming strongly compressed laterally in ripening, ultimately bicarinate by the prominent, thick sutures, low-convex toward the middle of the two faces, the thick, green, densely strigulose valves becoming stiffly papery or somewhat cellular-spongy, the stramineous, faintly reticulate, longitudinally wrinkled exocarp at length exfoliating along the length of the ventral suture from the cellular mesocarp and ultimately recurving in the form of 2 horizontally spreading vanes; *dehiscence* of the firmly papery endocarp apical and finally downward through the ventral suture; *ovules* 39–57; *seeds* brown or orange-brown, pitted, sublustrous, 2–2.4 mm. long.—Collections: 14 (iii); representative: *Jones* (from Spring Glen) in 1896 (GH, NY, POM), 5445f (NY, UC); *Ripley & Barneby* 4705 (CAS, RSA); *Barneby* 12,688, 12,696 (CAS, RSA); *Holmgren & Hansen* 3307 (NY).

Cobblestone bluffs, river terraces, and on saddles or along draws in gullied clay hills, in loose gravelly clay alluvia, 4900–5800 feet, reportedly (*Jones*, ex char., but probably in error) up to 7000 feet, locally plentiful but known only from the north and northwest edge of the Colorado Basin on the San Rafael, Price, and Green Rivers in Emery, Carbon, and Grand Counties, Utah.—Map No. 93.—Late April to June.

ASTRAGALUS CYMBOIDES (boat-shaped, of the dehiscent pod) *Jones* in Proc. Calif. Acad. Sci. II, 5: 650. 1895.—“No. 5658q. July 21, 1894, Cottrell’s Ranch, Henry Mts. . . No. 5464j. June 16, 1894, Huntingdon, Utah, in clay, 5000° alt. No. 5445f. June 16, 1894, near Emery, Utah, 7000° . . .”—Lectotypus (*Barneby*, 1947, p. 449), *Jones* 5464j, POM! isotypus, NY!—*Xylophacos cymboides* (*Jones*) *Rydb.* in Bull. Torr. Club 40: 49. 1913.

Astragalus amphioxys var. *cymbellus* (a little boat, of the pod) *Jones*, Rev. Astrag. 215, Pl. 51. 1923.—“Common in the San Rafael Swell and the western side of the Navajo Basin . . .”—Lectotypus (*Barneby*, 1947, p. 449), *Jones* from San Rafael Swell, May 28, 1914 (fruct. only, the flowering element = *A. amphioxys*), POM!

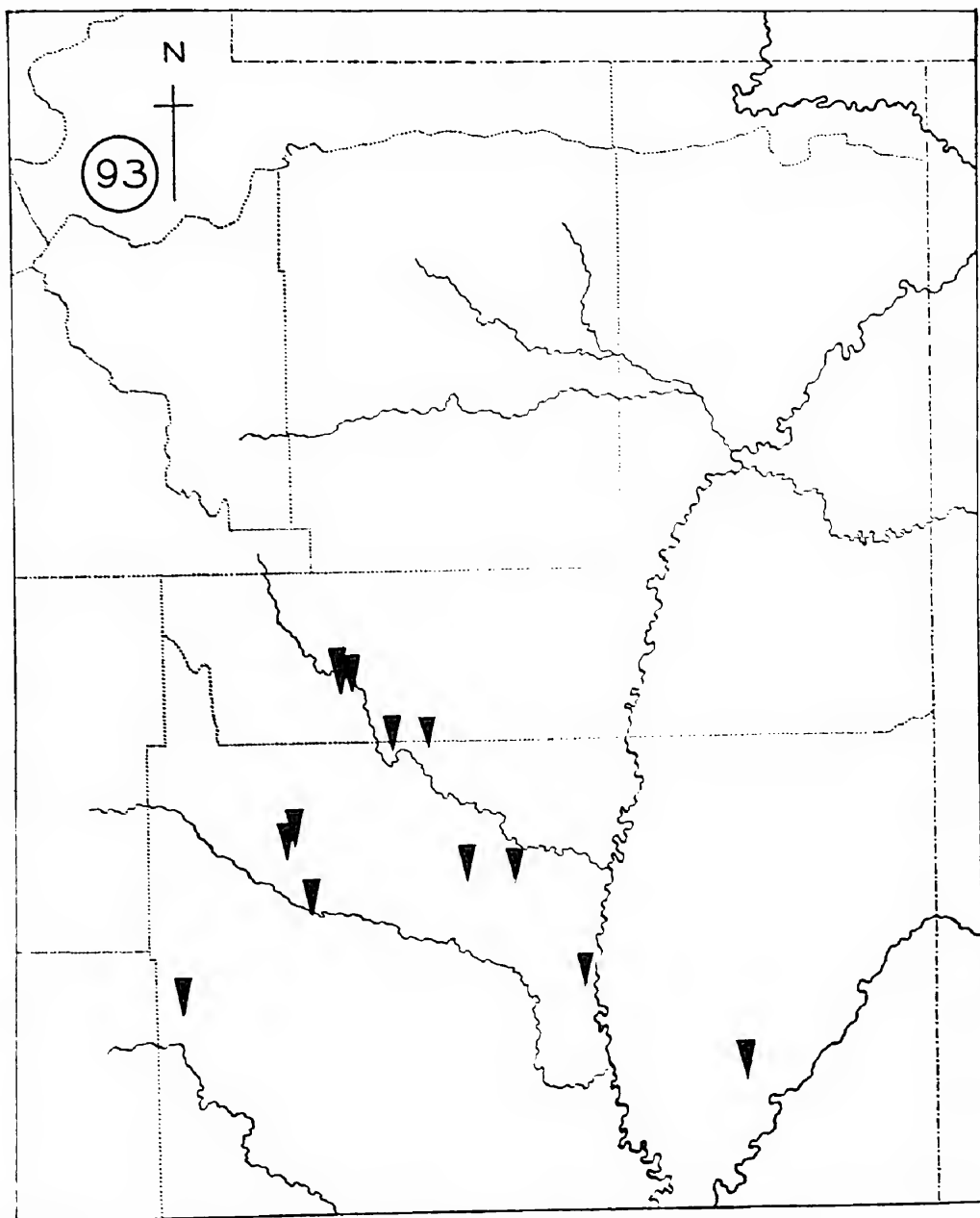
The canoe milk-vetch, *A. cymboides*, is closely related to *A. amphioxys*, differing principally in the pod, which when ripe is almost straight, laterally compressed, and of a light pithy texture. Its mode of dehiscence by exfoliation of the exocarp is characteristic and unique in the genus. The ranges of *A. cymboides* and *A. amphioxys* overlap in Emery County, and flowering specimens are sometimes difficult to assign to their species. The flower of the canoe milk-vetch is ordinarily smaller and of paler color, but we have a few ambiguous examples, already mentioned in the preliminary revision (*Barneby*, 1947, p. 449). Measurements of the relatively large, bright purple, *amphioxys*-like flowers of these puzzling specimens have been included (in parentheses) in the foregoing description, but it remains an open question as to whether they really represent part of the normal range of variation. The type-collection of var. *cymbellus* consists of a mixture of flowering *A. amphioxys* and typical *A. cymboides* in fruit, and the same mixture may have occurred unrecognized more than once. It has been suggested that *A. cymboides* may hybridize with *A. amphioxys* var. *vespertinus*, but the hypothesis needs testing in the field.

The range of the canoe milk-vetch is apparently defined at its northern limit by the cliffs of the Tavaputs Escarpment, an obstacle which has been a barrier to the spread of many

species in the Colorado Basin. It was reported, on the basis of a single specimen in flower, from Dinosaur Monument (Graham, 1937, p. 247), but this record is probably mistaken.

225. *ASTRAGALUS MISSOURIENSIS*

Low, loosely tufted or prostrate, shortly caulescent or sometimes subacaul-
escent, with a taproot and at length loosely forking, scarcely suffruticlose caudex
(the branches occasionally up to 2 dm. long, usually much shorter), densely
strigulose or strigose throughout with straight, parallel, often contiguous, lustrous
hairs up to 0.7–1.25 mm. long, the herbage silvery-white to greenish-gray, the



Map No. 93. Northeastern Utah. Range of *A. cymboides*.

leaflets subequally pubescent on both sides; *stems* of the year commonly somewhat developed (in some young or starveling individuals reduced to sessile crowns), up to 1.5 dm. long, mostly shorter, prostrate and radiating, the internodes sometimes concealed by stipules, but some, especially those preceding the peduncles, up to 1.5–2.5 cm. long; *stipules* (2) 3–9 mm. long, firm or submembranous, becoming scarious or papery and brownish, ovate or triangular-acuminate, fully or semi-amplexicaul-decurrent, free (or the lowest exceptionally shortly connate); *leaves* (2) 4–14 cm. long, with flaccid, deciduous or weakly persistent petiole and (5) 11–17 (21) elliptic to narrowly obovate, acute or mucronulate, sometimes mostly obovate and obtuse, flat leaflets 3.5–13 (17) mm. long; *peduncles* (1.5) 3.5–11 cm. long, usually stout, stiff, and persisting into a second season, ascending in flower, prostrate in fruit; *racemes* loosely but shortly, sometimes subumbellately (3) 5–15-flowered, the flowers ascending or in age spreading, the axis little elongating, (0.5) 1–4 cm. long in fruit; *bracts* membranous with green midrib, narrowly lance- or rarely ovate-acuminate, 2.5–8 mm. long; *pedicels* mostly straight and ascending, rarely a little arched outward, 1–1.7 mm. long at anthesis, thickened, persistent, 1.8–3.5 mm. long in fruit; *bracteoles* 0–2, sometimes conspicuous; *calyx* 5–12 mm. long, strigulose with mixed black and white, or more rarely all white hairs, the somewhat oblique disc 1–1.6 (2) mm. deep, the purple-tinged tube cylindric or deeply campanulate, the subulate or less commonly deltoid teeth 0.7–3.3 (5.3) mm. long; *petals* (except in rare albinos) pink-purple, with a pale lozenge in the fold of the banner, drying dull bluish; *banner* recurved through $\pm 45^\circ$, rhombic-ovate, obovate-cuneate, or broadly elliptic-oblongate, 9.5–22 (24) mm. long; *wings* nearly as long to considerably shorter, the blades narrowly oblong or lance-oblong, obtuse, slightly incurved in the distal half; *keel* 8.9–17.3 (18.5) mm. long, the lunately half-obovate blades 5.3–8 (9) mm. long, incurved through ± 90 – 95° to the rounded apex; *anthers* (0.5) 0.55–0.8 mm. long; *pod* ascending (humistrate), sometimes through accidental twisting of the pedicel apparently spreading or declined, sessile and (commonly) persistent on the receptacle, subsymmetrically or (in one var.) obliquely oblong or oblong-elliptic in outline, 1.4–2.7 (3) cm. long, (4) 5–9 (10) mm. in diameter, obtuse or sometimes cuneate at base, abruptly contracted distally into a subulate, pungent, or triangular-acuminate and laterally compressed beak, variably compressed, the green, fleshy, strigulose valves becoming stiffly leathery or subligneous, 0.3–0.5 mm. thick when dry, transversely reticulate and wrinkled lengthwise, brownish and ultimately black, either not inflexed, or often so far so as to form a distinct septum up to 1.1 mm. wide; *dehiscence* primarily through the beak, ultimately downward through the distal half or whole length of the ventral suture, the tips of the valves twisted outward in age, the dorsal suture also inclined to split and expose the endocarp or the outer (conduplicate) walls of the septum; *ovules* (33) 36–50 (56); *seeds* brown, pitted or wrinkled, somewhat lustrous, 2–3 mm. long.

Over the greater part of its immense range east of the Continental Divide, the Missouri milk-vetch is a comparatively stable species. In the middle Rio Grande Valley in New Mexico and thence northward into Colorado, the racial situation is suddenly complicated by striking mutations and possibly by hybridization with *A. amphioxys*. Three varieties have been recognized.

Key to the Varieties of *A. missouriensis*

1. Flowers large, the calyx 9–14 mm., the banner 14.5–24 mm., the keel 11.5–18.5 mm. long; widespread (2)
2. Pod subsymmetrically oblong-elliptic in outline, straight or nearly so, subcylindric when first formed, becoming laterally compressed and bicarinate by the salient sutures, the lateral faces transversely dilated and convex; widespread e. of the

Continental Divide from s. Canada to w. Texas, extending around the s. foothills of the Rocky Mountains to the upper San Juan River in n.-w. New Mexico and s.-w. Colorado _____ 225a. var. *missouriensis*

2. Pod obliquely ellipsoid, lunately incurved, obcompressed below the incurved beak; w. slope of the Rocky Mountains in Colorado s.-ward from the Grand River, extending into closely adjoining s.-e. Utah and e. across the Continental Divide into Conejos County, Colorado _____ 225b. var. *amphibolus*

1. Flowers small, the calyx 5–5.8 mm., the banner 9.5–11.8 mm., the keel 8.9–10.6 mm. long; pod almost that of var. *missouriensis*; w.-centr. New Mexico _____ 225c. var. *mimetus*

225a. ASTRAGALUS MISSOURIENSIS var. MISSOURIENSIS

Variable in habit as described for the species; calyx 9–12 (14.3) mm. long, the tube 6.3–9 (9.3) mm. long, 3.3–4.6 (4.9) mm. in diameter, the teeth 1.4–3.3 (5.3) mm. long; banner (14.5) 16–22 (24) mm. long, (7.2) 8–12.5 mm. wide; wings (13) 13.6–19.8 (23.3) mm. long, the claws 6.8–10 (10.8) mm., the blades 8–11.1 (12.2) mm. long, 2.4–3.7 (4) mm. wide; keel (11.5) 12.8–17.3 (18.5) mm. long, the claws 6.8–10 mm., the blades (5.3) 6–8 (9) mm. long, 2.6–3.8 mm. wide; pod 1.5–2.7 (3) cm. long, (4) 5–9 (10) mm. in diameter, obtuse or sometimes cuneate at base, abruptly contracted distally into a subulate, pungent beak 1.5–4 mm. long, at first subterete or a trifle dorsiventrally compressed, when ripe somewhat laterally compressed and subquadrangular, bicarinate by the straight, parallel, or subequally convex, thickened, salient sutures, the middle of the valves transversely dilated and obtuse-angled; ovules (33) 40–50 (56).—Collections: 198 (xxv); representative: *Macoun* 4204 (GH, NY), 4205 (GH, MINN, NY); *Moyer* (from Granite Falls, Minnesota) in 1910 (GH, MINN, OB); *Hitchcock & Muhlick* 11,812 (CAS, RSA, WS); *C. L. Porter* 5336 (CAS, TEX); *Horr* E530 (OKLA, SMU, TEX, WS); *W. A. Weber* 3275 (CAS, TEX, WS); *C. F. Baker* 417 (GH, NY, POM); *Fendler* 149 (GH, NY); *Thurber* 142 (GH); *Ripley & Barneby* 4206 (CAS, RSA); *B. & H. Jespersen* 2656

Prairies, bluffs, and gullied hillsides, in dry open places, on a variety of sedimentary and alluvial soils but most abundant and vigorous on limestones, shales and sandstones, southward often on gypsum, ascending to 7300 feet in the Rocky Mountain foothills and to 7800 feet in northern New Mexico, widespread and common over the Great Plains from southern Alberta and southwestern Manitoba to northwestern and trans-Pecos Texas, east to the Missouri Valley in western Iowa, central Kansas, and western Oklahoma, west to the upper Missouri in Montana, to Yellowstone Park, and thence south along the Rocky Mountain piedmont to the Rio Grande Valley; extending west in New Mexico and southwestern Colorado to the headwaters of the San Juan River.—Map No. 94.—Late March to July, according to altitude and latitude.

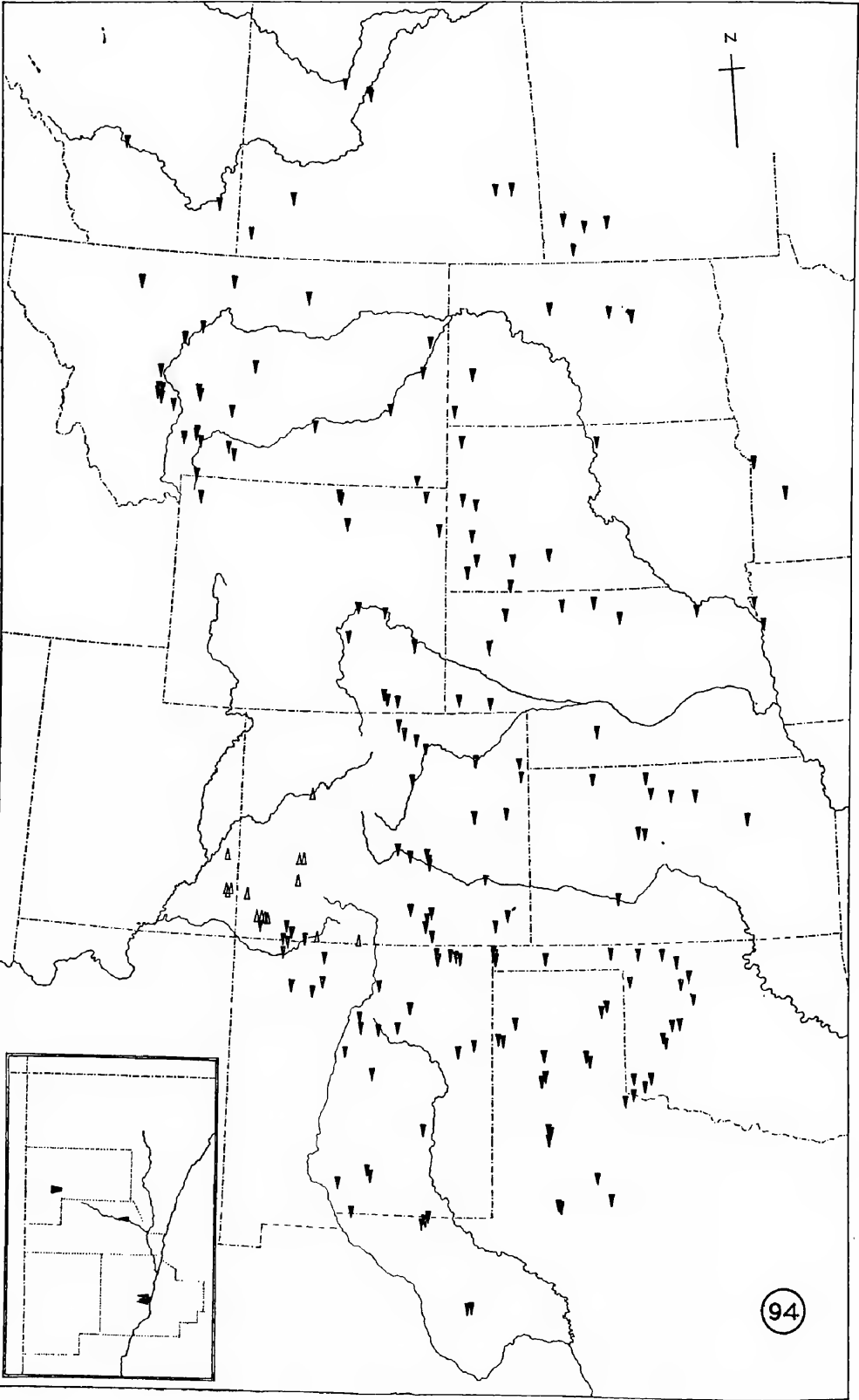
ASTRAGALUS MISSOURIENSIS (of the Missouri River) Nutt., Gen. N. Amer. Pl. 2: 99. 1818. —“On hills throughout Upper Louisiana...” Lectotypus, labeled “Louisiana, Bradbury, 1811–12.” BM! isotypus, labeled “Louisiana, Nuttall, from Lambert’s herb.” PH (herb. Pursh.)! probable isotypus, labeled “Nuttall ex herb. Lambert.” NY!—*Tragacantha missouriensis* (Nutt.) O. Kze., Rev. Gen. 946. 1891. *Xylophacos missouriensis* (Nutt.) Rydb. ap. Small, Fl. S. E. U. S. 620, 1332. 1903. *A. missouriensis* var. *typicus* Barneby in Amer. Midl. Nat. 37: 444. 1947.

Astragalus melanocarpus (with black pod) Nutt., Fraser’s Cat. 1. 1813, nom.; Richards., Bot. Append. Franklin’s Jour. 746 (in separate 28). 1823, nom.; Hook., Fl. Bor.-Amer. 1: 150. 1831, in syn.

Astragalus missouriensis β T. & G., Fl. N. Amer. 1: 331. 1838—“In the Rocky Mountains, Nuttall.”—Holotypus, NY!

Astragalus missouriensis fma. *longipes* (with long peduncles) Gand. in Bull. Soc. Bot. France 48: xv. 1902.—“S. Dakota ad Piedmont (A. Pratt).”—Holotypus, collected by Alice D. Pratt in June, 1895, LY! isotypi, GH, MINN, WIS!

Astragalus missouriensis fma. *microphyllus* (small-leaved) Gand., l.c. 1902. (“micro-



phylla”).—“A. Nelson exs. no. 1227... Hab. Wyoming, ad Laramie (A. Nelson).”—Holotypus, dated May 20, 1895, LY! isotypi, RM, WS!

Astragalus missouriensis fma. *leucophaeus* (white and fuscous, the calyx-hairs of mixed color) Gand. in op. cit.: xvi. 1902 (“*leucophaea*”).—“Hab. Colorado, ad Fort Collins (C. Crandall).”—Holotypus, dated May 24, 1898, LY! a probable isotypus from Fort Collins, *Crandall in 1898*, NY!

The Missouri milk-vetch, an astragalus common over the higher plains east of the Rocky Mountains, was first encountered in September, 1804, by Lewis and Clark (No. 36, PH), but was described from plants collected seven years later by Nuttall and Bradbury. Nuttall applied two epithets to the species, *A. missouriensis* being first listed in the Fraser Brothers' catalogue as *A. melanocarpus*, in reference to the fruit which turns black after dehiscence. There are Nuttall specimens from the Platte labeled by Nuttall himself as *A. melanocarpus* (BM, K); but although the name was listed by Hooker and by Richardson, it was never associated with a description except as a synonym. A plant in the Torrey herbarium (NY) labeled *A. melanocarpus* by Nuttall formed the basis of *A. missouriensis* β of Torrey & Gray.

Over the greater part of its range var. *missouriensis*, with the exception of *A. lotiflorus*, is the only low tufted or subcaulescent milk-vetch with pinnate foliage and dolabriform vesture. It may be distinguished at all seasons either by its longer, narrower flower and subcylindric calyx-tube or by the straight, at first terete but at length laterally compressed pod which often remains attached to the plant on a withered peduncle well into the second year. In New Mexico its range closely approaches and even overlaps to some extent that of the related and habitually similar *A. amphioxys*; in this region well-formed fruits are required for positive identification. The typical Missouri milk-vetch is subject to considerable variation in the size of the flower and pod. The smallest flowers are found chiefly northward from the Fortieth Parallel, whereas the largest are prevalent only on calcareous or gypseous soils toward the southern limit of the species-range. Intergradation between the extremes in flower-size is gradual and complete, offering no convenient point at which the material examined could be divided into two natural series. An especially handsome form of var. *missouriensis*, seen in flower in the foothills of Guadalupe Peak in western Texas, remains in my memory as one of the showiest North American *Astragali*.

A remarkable form of *A. missouriensis*, locally common on barren clay hills about Pagosa Springs in Archuleta County, Colorado, deserves special mention and a brief description:

Caulescent, the stems and caudex-branches together 7–20 cm. long; *stipules* 2–11.5 mm. long, all fully amplexicaul and connate; *bracts* submembranous, lance-acuminate or -caudate, 4–10 mm. long; *calyx* 7.8–10 mm. long; *banner* 19–20.5 mm. long; *pod* oblong-ellipsoid, straight, about 1.7–2 cm. long, glabrous or very sparsely pubescent along the ventral suture and on the beak; *ovules* 33–40.—Collections: *Bethel, Willey & Clokey 4181* (WS); *Ripley & Barneby 7585* (RSA).

In general appearance these plants are reminiscent of *A. humistratus* var. *humistratus* with which they have in common technical attributes of connate stipules and conspicuous bracts of thin texture; but the pod, except that it is glabrous or nearly so, is precisely that of *A. missouriensis* in form, texture, and compression. It is probably no coincidence that *A. humistratus* reaches its northern limit at Pagosa Springs (*Bethel & al. 4172*), for the material is persuasively suggestive of a hybrid origin. Unfortunately we lack fruit sufficiently mature to show whether it disjoints or not at full maturity, so an attempt to interpret the status and relationships of what is now apparently a self-perpetuating entity is best postponed until the problem can be studied in the field.

225b. ASTRAGALUS MISSOURIENSIS var. AMPHIBOLUS

Habit and flowers of var. *missouriensis*; *leaflets* rather few, mostly (5) 7–15; *calyx-tube* 7–10 mm., the teeth 1.5–3 mm. long; *pod* obliquely ellipsoid, 1.5–2.5 cm. long, 7–9 mm. in diameter, lunately incurved, broadly cuneate or cuneately attenuate at base, triangular-acuminate at apex, strongly obcompressed below the beak, either long-persistent on the receptacle or tardily deciduous.—Collections: 17 (vi); representative: *C. F. Baker 331* (MINN, ND, NY, POM); *Rydberg & Garrett 9135* (NY); *Ripley & Barneby 5391* (CAS, RSA); *Barneby*

Map No. 94. The Rocky Mountain and Prairie States and Provinces and, inset, northwestern New Mexico. Range of *A. missouriensis*: $\blacktriangledown$ var. *missouriensis*; $\blacktriangleleft$ var. *amphibolus*; and $\blacklozenge$ var. *mimetus*; and of $\blacklozenge$ *A. accumbens*.

13,022 (CAS, NY, RSA); *Diehl* (from Glenwood Springs, Colorado) in 1899 (POM).

Dry hillsides, plains and valley floors, with piñon, juniper, or sagebrush, on granitic, volcanic or sandstone bedrock, 5800–8200 feet, locally plentiful in scattered stations on the west slope of the southern Rocky Mountains in Colorado, from the Grand River in Garfield County south through the Gunnison, Mancos, and San Juan Valleys, east to the headwaters of the Rio Grande in Conejos County, west into the foothills of the La Sal and Abajo Mountains in Grand and San Juan Counties, Utah.—Map No. 94.—May to July.

ASTRAGALUS MISSOURIENSIS var. *AMPHIBOLUS* (ambiguous, combining features of *A. missouriensis* and *A. amphioxys*) Barneby in Amer. Midl. Nat. 37: 447. 1947.—“Mancos, Montezuma Co., Colorado, *Baker, Earle & Tracy No. 56* . . .”—Holotypus, collected June 22, 1898, NY! isotypi, CAS, MINN, ND, POM, RM!

The var. *amphibolus* is locally abundant on the sagebrush plains extending east from Monticello into Colorado, and it is here most certainly, as probably throughout its range, a fixed self-perpetuating entity. However it seems likely that it arose in the first place as a hybrid involving var. *missouriensis*, with which it is sympatric in a small sector of its range, and *A. amphioxys*, found in the form of var. *vespertinus* at the western periphery of its area, although at lower elevations. We have at present too few examples of the fully ripe fruit to determine how often the pod remains attached to the receptacle after dehiscence. Pods persistent on peduncles of the preceding year, a feature characteristic of var. *missouriensis*, have been seen in var. *amphibolus* from the Abajo Mountains and the Mancos Valley, but a plant from Ouray County, Colorado, collected in July, had already shed its fruit in the manner of *A. amphioxys*. If the hypothesis of a hybrid origin is correct, variation of this nature might be expected in different populations of the variety.

225c. *ASTRAGALUS MISSOURIENSIS* var. *MIMETES*

Growth-habit wholly of var. *missouriensis*, but differing in the flower, this nearly identical in form but greatly reduced in size; *calyx* 5–5.8 mm. long, the tube 4.1–4.8 mm. long, 2.3–2.8 mm. in diameter, the teeth 0.7–1.1 mm. long; *petals* bright pink-purple; *banner* 9.5–11.8 mm. long, 6.6–9 mm. wide; *wings* 9.4–10.8 mm. long, the claws 3.6–4.8 mm., the blades 6.5–7.3 mm. long, 1.7–2.6 mm. wide; *keel* 8.9–10.6 mm. long, the claws 3.6–5 mm., the blades 5.4–6.3 mm. long, 2.5–3 mm. wide; *pod* as in var. *missouriensis*, 1.4–2.4 cm. long, 5–7.5 (9) mm. in diameter; ovules 36–46.—Collections; 6 (i); representative: *Wooten 3841* (NMC); *Castetter 5914* (herb. Univ. New Mex.); *Eggleston 16,244* (NY).

Low gravelly hills, stony washes, and arid clay banks, with *Larrea* or junipers, 4600–5800 feet, known only from the west side of the Rio Grande Valley in eastern Valencia and western Socorro Counties, New Mexico.—Map No. 94.—April to May, sometimes again in fall.

ASTRAGALUS MISSOURIENSIS var. *MIMETES* (mimic, closely simulating *A. accumbens*), var. nov., a var. *missouriensi* floribus multo minoribus (calyce $\pm$ 5–6 mm., vexillo 9.5–11.8 mm., carina $\pm$ 9–10.5 mm. longis) absimilis.—NEW MEXICO: Laguna, Valencia County, 5800 ft., September 6, 1956, *Barneby 12,981*. Holotypus, CAS! isotypi, NY, RSA!

The var. *mimetes* is a neatly attractive little astragalus, differing from the widespread var. *missouriensis* in the much smaller flower. It is of theoretical interest because it forms a link between its species and *A. accumbens*, and furnishes evidence bearing on the problem of the latter's origin and relationships. This point is discussed under the next species. The variety, first collected at Laguna in 1884 by J. G. Lemmon (GH), has been confused consistently with *A. accumbens*, a species differing in its yet smaller flower, more abruptly incurved petals, and shorter, fewer-ovulate pod.

226. *ASTRAGALUS ACCUMBENS*

Low, tufted, acaulescent or shortly caulescent, with a pluricipital root-crown or loosely forking suffruticulose caudex, densely strigulose with rather coarse,

straight and parallel, truly appressed hairs up to 0.6–0.9 mm. long, the herbage silvery or sometimes greenish-cinereous; *stems* commonly a little developed, 0–4 (6) cm. long, prostrate, the internodes all short, up to 8 mm. long, the leaves mostly appearing radical or truly so; *stipules* submembranous, (2) 2.5–5 mm. long, ovate-triangular or broadly lanceolate, semi- or fully amplexicaul but none connate; *leaves* (1) 2–6.5 cm. long, with slender petiole and 7–15 obovate, oval, or elliptic-oblancheolate, mostly obtuse but sometimes subacute or obscurely emarginate, flat or loosely folded, dorsally subcarinate leaflets 2–8 (11) mm. long; *peduncles* slender but wiry, often long-persistent, 3–6.5 cm. long, at anthesis incurved-ascending, prostrate in fruit; *racemes* very shortly but rather loosely (3) 5–14-flowered, the flowers widely ascending or the lowest a trifle declined in age, the axis little elongating, 4–15 mm. long in fruit; *bracts* membranous, ovate or lance-ovate, 1.5–2.7 mm. long, *pedicels* at anthesis ascending, 0.7–1.3 mm. long, in fruit arched outward, somewhat thickened, 1.2–1.6 mm. long, persistent; *bracteoles* 0; *calyx* 4.6–5.1 mm. long, strigulose with mixed black and white or sometimes all white hairs, the subsymmetric disc 0.5–0.9 mm. deep, the campanulate tube 3.5–3.9 mm. long, 2.3–2.5 mm. in diameter, the subulate teeth 1–1.6 mm. long; *petals* ochroleucous with indistinct, dull lilac veins, or the banner and wings distally tinged with dull lilac; *banner* abruptly recurved through 90–100°, broadly ovate- or suborbicular-cuneate, shallowly notched, 7–8.3 mm. long, 5.4–7 mm. wide; *wings* slightly longer, 7.6–8.9 mm. long, the claws 3.5–4.3 mm., the oblong, obtuse blades 4.6–8.9 mm. long, 1.5–1.8 mm. wide, both gently incurved, the inner margin of both, or of the left one only, usually infolded; *keel* 6.9–7.8 mm. long, the claws 3.9–4.3 mm., the lunately half-circular blades 3.5–3.8 mm. long, 1.5–2.1 mm. wide, incurved through $\pm 120^\circ$ to the subacute, triangular, minutely porrect apex; *anthers* 0.35–0.4 mm. long; *pod* spreading or ascending (humistrate), long-persistent (often over winter) on the receptacle, plumply ovoid or oblong-ellipsoid, straight or nearly so, 9–18 mm. long, 4–7 (8) mm. in diameter, rounded at base, abruptly contracted distally into a stout cusp 1–2 mm. long, solid and subterete when first formed, becoming either a little laterally compressed and bicarinate by the prominent sutures, or somewhat flattened dorsally and then obscurely trigonous when ripe, the fleshy, green, smooth and lustrous, strigulose valves ± 1.5 mm. thick when first formed, becoming leathery, brown or ultimately almost black, reticulate and rugulose, either not inflexed, or inflexed as a rudimentary septum up to 1.2 mm. wide; *dehiscence* apical, and ultimately downward through the length of the ventral suture, the valves curling backward and gaping to release the seeds; *ovules* 22–32; *seeds* not seen.—Collections: 5 (ii); representative: *Palmer* (sine loc.) in 1869 (GH, NY, US); *Ripley & Barneby* 5273 (CAS, RSA), 8417 (CAS, NY, RSA); *C. C. Marsh* (sine loc.) in 1883 (US).

Gravelly clay banks and knolls, in stiff, dry, alkaline soils derived from sandstone, ± 7500 –7900 feet, rare and local, known only from the north slope of the Zuni Mountains, McKinley County, New Mexico.—Map. No. 94.—May to July.

ASTRAGALUS ACCUMBENS (reclining, of the peduncles) Sheld. in Minn. Bot. Stud. 1: 20. 1894, a legitimate substitute for *A. procumbens* (prone) Wats. in Proc. Amer. Acad. 20: 361. 1885 (non Mill., 1768).—"Near Fort Wingate, New Mexico, by Dr. W. Matthews, U.S.A., in 1882, and 1883, and near the Indian village of Laguna, Lemmon, 1884."—Holotypus, collected by Matthews in 1882, GH! isotypus, K! The paratypus, *Lemmon 3232* (GH) = *A. missouriensis* var. *mimetes*.—*Batidophaca accumbens* (Sheld.) Rydb. in N. Amer. Fl. 24: 317. 1929.

The affinities of the Zuni milk-vetch, *A. accumbens*, have been the subject of widely divergent opinions. Jones (1923, p. 177) assigned the species to sect. *Lotiflora*, but implied its isolation from the two other members of the group by placing it in a monotypic subsect. *Accumbentes*. Rydberg (1929, l.c.) transferred it to *Batidophaca* and associated it with *A.*

gilensis, with which it has a good deal in common—growth-habit, dolabriform pubescence, and small flowers. I have already mentioned it (1947, p. 424) as seeming to form with *A. musimonum* a discrete group suggestive of *Argophylli* reduced to a minor key. These two species are interpreted here as genuine *Argophylli* derived by parallel modification of the flowers from *A. amphioxys* and *A. missouriensis* respectively.

The most remarkable feature of *A. accumbens* is the persistent pod which is continuous with the receptacle and remains attached to it long after dehiscence, often into the following spring. In this respect the fruit is like that of *A. missouriensis*, which it resembles even further in its essential form, texture, and compression, differing only in being shorter and of plumper outline. It is only the flower, with its campanulate calyx and strongly incurved, short-clawed petals, which has provided an apparently secure basis for excluding the species from the *Argophylli*, and the recognition of *A. missouriensis* var. *mimetes* has removed this obstacle. The earliest collections of *A. accumbens* and of var. *mimetes* were cited together by Watson in the original description of the Zuñi milk-vetch, and no further emphasis need be laid on the general similarity of the two. The flowers, however, are far from identical, those of var. *mimetes* being exactly as in *A. missouriensis* except for their small size, whereas the petals of *A. accumbens* are not only even a little shorter and of pallid hue but also much more strongly incurved and poorly or somewhat irregularly graduated. This alteration in proportion and orientation of the flower-parts may have occurred as a mutation from *A. missouriensis* var. *mimetes* in the same way that *A. musimonum* is believed to have arisen from *A. amphioxys* var. *modestus*. The geographical isolation of the two modified species at the periphery of the range of their supposed ancestors suggests a recent origin of this type.

The Zuñi milk-vetch is a modest little astragalus, with small, ochroleucous flowers faintly tinged or veined with lilac. It is common very locally on gullied alkaline clay banks and knolls along the canyon leading south from Fort Wingate into the Zuñi Mountains and is known from no other recorded locality. In this place it is associated with the narrowly endemic *Erigeron rhizomatus* Cron., and it seems likely that the ecological niche has played a role in the genesis and survival of both species.

LVI (ix). Subsectio ANISI

Characters of subsect. *Missourienses* except for the (readily deciduous) broadly oblong or globose, dorsiventrally compressed, beakless, fully bilocular pod; *petals* pink-purple, poorly graduated, the keel 16.5–18.5 mm. long; *dehiscence* through both sutures and the septum, the ripe pod falling apart into two halves.—Sp. 1, xerophyte, of the middle Gunnison Valley, Colorado.

ASTRAGALUS sect. ARGOPHYLLI subsect. ANISI, subsect. nov., pube dolabriformi, caeterisque *Missouriensibus* persimiles, sed legumine oblongo-globose erostrato prorsus biloculari per septum et ambas suturas dehiscenti praestantes.—Sp. unica: *A. anisus* Jones.

227. ASTRAGALUS ANISUS

Dwarf, loosely tufted, subcaulescent or shortly caulescent, with a woody taproot and (in older plants) a shortly forking caudex beset with flaccid, brown tatters of marcescent leaf-bases, densely silvery- or gray-pilose and strigose with appressed and narrowly ascending, almost straight or some sinuous and spreading, dolabriform hairs up to 0.8–1.6 mm. long, the leaflets equally pubescent on both sides; *stems* up to 5 cm. long, leafy, simple or shortly spurred at base, the internodes mostly concealed by stipules, a few sometimes developed and up to 1 cm. long; *stipules* 4–6 mm. long, pallid, submembranous, deltoid- or lance-acuminate, semiamplexicaul-decurrent, free; *leaves* 2–7 cm. long, petioled, with (7) 11–15 obovate, obovate-cuneate, or subrhombic, obtuse leaflets 4–10 mm. long; *peduncles* 1.5–3 cm. long, arcuate-recurved in fruit; *racemes* loosely but shortly 3–7-flowered, the flowers ascending, the axis little elongating, 0.5–2.5 cm. long in fruit; *bracts* lanceolate or ovate-acuminate, 2.5–4.5 mm. long; *pedicels* ascending, at anthesis 1.5–2.5 mm., in fruit a little thickened, 2–4 mm. long, persistent; *bracteoles* 0–2; *calyx* 11–13 mm. long, densely strigose-strigulose with white and sometimes a few shorter black hairs, the disc 1.3–2.1 mm. deep, the cylindric tube obliquely obconic-attenuate at base, 9–10.5 mm. long, 3.3–4.3 mm. in diameter, the subulate teeth 1.5–3 mm. long, the orifice oblique; *petals* pink-purple, little

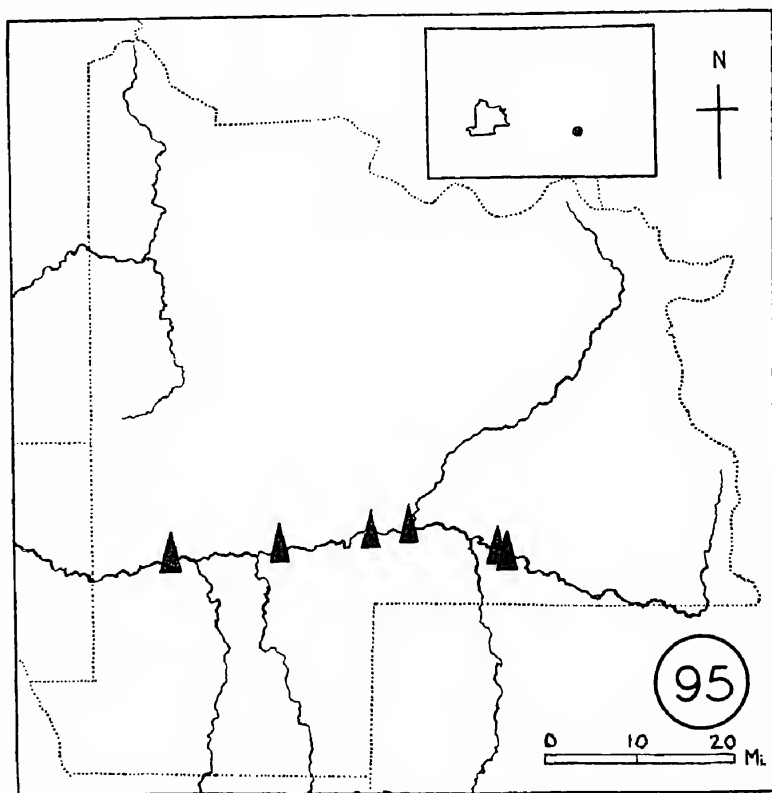
but regularly graduated; *banner* gently recurved through $\pm 40^\circ$, oblanceolate or spatulate, 18.8–21 mm. long, 8–12 mm. wide; *wings* 18.5–20.5 mm. long, the claws 10.5–13.5 mm., the oblong or lance-oblong, obtuse, straight blades 8.2–9 mm. long, 2.5–3.2 mm. wide; *keel* 16.5–18.5 mm. long, the claws 10.7–13.5 mm., the half-obovate blades 6–7 mm. long, 2.8–3.5 mm. wide, incurved through $70\text{--}80^\circ$ to the blunt apex; *anthers* 0.6–0.85 mm. long; *pod* ascending or loosely spreading (humistrate), sessile, deciduous, obliquely globose, oblong-globose, or broadly obovoid, (1) 1.3–1.8 cm. long, 8–13 mm. in diameter, turgid or moderately inflated, contracted at base into a short or obscure, obconic neck, minutely cuspidate at apex, straight or a trifle incurved, obcompressed and shallowly sulcate ventrally, flattened or rounded dorsally, the ventral suture either straight or shallowly concave in profile, the dorsal one convex throughout, often prominent and undulate, the fleshy valves becoming spongy and 0.3–0.4 mm. thick at maturity, then stramineous, irregularly rugulose but not (or vestigially) reticulate, finely strigulose with sinuous white hairs, inflexed as a complete septum 3–6 mm. wide; *ovules* 28–40; *seeds* soot-black, nearly smooth, dull, 2–2.4 mm. long.—Collections: 9 (v); representative: *W. A. Weber* 4706 (RSA); *Jean Langenheim* 1219 (CAS, NY, RSA); *Ripley & Barneby* 10,199, 10,207, 10,232 (RSA); *Barneby* 13,016 (CAS, NY, RSA).

Dry gravelly flats and hillsides, in sandy clay soils overlying granitic bedrock, usually among or sheltering under low sagebrush, 7500–7800 feet, known only from the valley of the Gunnison River for a distance of ± 40 miles upstream from the east portals of the Black Canyon, Gunnison County (the type-station near Pueblo almost certainly an error), Colorado.—Map No. 95.—May to July.

ASTRAGALUS ANISUS (unequal, presumably of the asymmetrically globose pod) Jones in *Zoë* 4: 34. 1893.—“Collected at Pueblo, Colo., by Miss A. P. Lansing, and communicated by Miss Alice Eastwood.”—Holotypus, collected in 1892, POM! isotypi, CAS, UC!

In growth-habit, malpighian hair-attachment, and fine details of the flower the Gunnison milk-vetch, *A. anisus*, closely resembles several species of the preceding subsect. *Missourienses*. There can be little doubt that its affinities lie in this direction rather than among the *Mollissimi* to which it was referred by Jones (1923, p. 235) and afterward by Rydberg (1929, p. 446). The presence of a septum, which sufficed to exclude *A. anisus* from *Xylophacos* as defined by Rydberg, can no longer be considered of fundamental systematic import; indeed already admitted to the equivalent sect. *Argophylli* are several species with partially or fully bilocular fruits. However the plumply oblong or globose, dorsiventrally compressed, essentially beakless pod of *A. anisus* and its mode of dehiscence, by splitting through the septum and subsequently separating into a pair of carpel-like structures closed by the lidlike septum, have no counterpart in the section and entitle the species to a subsection of its own. The detached pod of the Gunnison milk-vetch is similar in form to that of *A. crassicarpus* var. *cavus*, which also dehisces in the same manner; and although the species would surely be misplaced among the *Sarcocarpi*, we may well have here a further clue to a common ancestry for the *Argophylli* and the *pommes-de-prairie*.

The published type-locality of *A. anisus* was almost certainly the result of some error in memory or in labeling. The city of Pueblo stands at the eastern foot of the last mesas of the Rocky Mountain piedmont, in high prairie country, and repeated search for the species in the neighborhood has been unsuccessful. The available habitats are quite out of keeping with the environment and elevation of the upper Gunnison Valley, where the species is locally abundant, clearly native, and probably endemic. In 1948, already suspecting a mistake in the original data, and unaware that *A. anisus*, lost to view for fifty years, would be rediscovered the following spring by that keen observer William A. Weber, I made enquiries of Alice Eastwood about the circumstances of the type-collection. Miss Eastwood's characteristically vivid recollection was inconclusive so far as tracing the origin of the typus was concerned, yet her memories of the collector are worth permanent record: “Miss Alida Lansing was a protegee of mine when I taught in the Denver High School. She became interested in collecting beautiful specimens and pressing them to be made into cards or booklets for sale and she was financially successful. She married a lawyer and died about two years ago [ca. 1946]. She would not remember [where the astragalus was collected] even if she were alive and it is not at all



Map No. 95. Headwaters of the Gunnison River. Range of *A. anisus*. Inset, Colorado, showing relative positions of Gunnison County and Pueblo, the supposed type-locality.

unlikely that it might have been collected elsewhere. I named all her specimens . . . Miss Lansing's travels were quite extensive and I have no idea where she did her collecting."

Some "poor specimens" collected near Mancos, Colorado, early referred by Miss Eastwood (in *Zoë* 4: 16) to *A. anisus*, probably were lost in the 1906 fire. Jones surmised (*Contrib. West. Bot.* 13: 9) that they might represent *A. lutosus*, a narrow endemic of the Uinta Basin shales which could scarcely be expected so far south and could never be confused with *A. anisus* by so critical an observer as Alice Eastwood. Possibly the collection belonged to *A. missouriensis* var. *amphibolus*, of which Mancos is the type-locality and which greatly resembles *A. anisus* in habit of growth, dolabriform pubescence, and size and color of the flowers.

LVII. Sectio DESPERATI

Dwarf, subcaulescent, or shortly caulescent, tufted perennials (sometimes flowering the first season), with superficial root-crown or caudex; *vesture* basifixed; *stipules* mostly imbricated, free or connate; *leaves* imparipinnate, with wiry, often marcescent petiole and 7–17 (21) readily deciduous leaflets; *racemes* loosely 2–15-flowered, sometimes subumbellate, the flowers small or smallish, the banner 7.5–15.5 mm. long; *calyx-tube* campanulate or cylindric; *petals* pink-purple, bi-colored (whitish tipped with purple), or ochroleucous (veined with purple), regularly graduated, the keel-tip rounded or rarely narrow-deltoid; *pod* either deflexed or ascending (humistrate), sessile, readily deciduous from the receptacle or from a short gynophore, obliquely ovate to narrowly oblong-elliptic or linear-lanceolate in profile, gently to strongly incurved, not or decidedly inflated, $\pm$ obcompressed to compressed-triquetrous, uni-, semibi-, or fully bilocular, the valves leathery or thinly papery; *dehiscence* apical (and sometimes also basal)

after falling; *ovules* 8–31.—Spp. 4, small, tufted xerophytes of rimrock pavement and talus under cliffs, associated with red and white sandstones of the Colorado Basin, southeastern Utah, northern Arizona, and western Colorado.

ASTRAGALUS sect. DESPERATI, sect. nov., inter *Argophyllos* et *Inflatos* quasi intermedii, ab his caulibus subnullis vel brevissimis foliolisque a petiolo rigidiusculo mox deciduis, ab illis leguminis valvulis plerumque tenuiter chartaceis tuboque calycino saepissime campanulato absimiles. Legumen oblique ovoideum, anguste oblongo-ellipsoideum vel lineari-lanceiforme, nunc dorsiventraliter nunc triquetrum compressum, $\pm$ incurvum mire variat uni-, semibi- et biloculare, semper post lapsum dehiscens.—Perennes, pumili, pube basifixa vestiti, foliolis 7–17 (21), racemis laxe (saepe breviter) racemosis, floribus parvulis.—Sp. typica: *A. desperatus* Jones.

The sect. *Desperati* is a peculiarly fascinating group of species notable for the environmental specialization of all its members and for the extreme rarity of all but one of them. Beyond that, it is of theoretical interest because of the modifications achieved in the pod's structure and compression without any gross accompanying alteration in habit of growth or, in most cases, any perceptible change in the proportions of the flower. The pod varies in texture from papery to leathery, in compression from dorsiventrally flattened to compressed-triquetrous, in orientation from sharply deflexed to ascending and humistrate, and the cavity varies from strictly unilocular to fully bilocular. Because of this polymorphism of the pod and of a few other features of the plants, it is not possible to define sect. *Desperati* in terms which permit a simple dichotomous contrast of the whole group with either sect. *Argophylli* or sect. *Inflat*; it is so heterogeneous in detail that it defies a purely technical alignment. Features common to all members are the subcaulescent habit, large, papery stipules, a peculiar but indefinable facies, and the obligate habitat on ledges and saucer-like depressions of sandstone rimrock. The name-bringing species, *A. desperatus*, at least in its commonest phase (var. *desperatus*), would naturally be sought among the *Inflat* and is, as a matter of fact, often confused with a sympatric member of that section, *A. sabulorum*, from which it differs principally in its enlarged stipules and loss of a developed stem. In *A. desperatus* var. *conspicuosus* the stem is sometimes longer than the peduncles, but since this is accompanied by a flower much longer and narrower than that of the *Inflat*, the variety would be less out of place among the *Argophylli*. The shortly campanulate calyx and narrow, trigonous pod of *A. deterior* are suggestive of some anomalous *Inflat*, such as *A. sparsiflorus* var. *majusculus* or *A. diaphanus*, but the acaulescent habit of growth is conspicuously different. It would be reasonable to seek *A. naturitensis* among the *Argophylli*, where it would find an apparently natural place in the neighborhood of *A. zionis*; but its obviously close relative is *A. deterior*, of which the trigonous, semibilocular pod elevated on a short gynophore, shortly bell-shaped calyx, and narrow keel-tip would be anomalous in that setting. Finally *A. monumentalis*, which is scarcely distinguishable from *A. naturitensis* until the pod has formed, has a compressed-triquetrous, fully bilocular fruit of narrowly lanceolate or linear profile suggesting that of the *Micranthi*. Had it been discovered earlier Rydberg would have been obliged to refer it to *Hamosa* rather than to *Xylophacos* or *Phaca*, the equivalents of our *Argophylli* and *Inflat*.

It might be argued that the four *Desperati* have retained the crucial clues to their origins and relationships in the pod, and that the resemblance in facies is no more than a result of convergent evolution and directly related to their adaptation to the same narrowly controlled environmental niche. This hypothesis cannot be ruled out entirely, but it seems to me improbable to the highest degree. During the preliminary studies I considered dispersing the *Desperati*, two apiece, among the *Argophylli* and *Inflat*, but they introduced so many new or anomalous features into each section that the arrangement was not satisfactory. In the summer of 1961 I had the opportunity to collect all four members of the section within a space of four days, and the resemblances impressed me so greatly that I have felt fully justified in recognizing the *Desperati* as a natural group of individually specialized types.

The relationship of sect. *Desperati* is implicit in what has been said already about its component members. Collectively they combine features of sects. *Argophylli* and *Inflat*, and they are presumably derived from the stock which gave rise to both these massive groups. The existence of other sections more or less intermediate between the *Inflat* and *Argophylli* (e.g., sect. *Megacarpi* or sect. *Lotiflori*) points to a common origin for all these piptoloboid groups and a much closer relationship among them than postulated by Jones (1923, p. 27).

Key to the Subsections of Sect. *Desperati*

1. Pod declined or deflexed, lunately to annulately incurved, dorsiventrally compressed and sulcate dorsally below the beak, $\pm$ inflated or turgid, uni- or subunilocular, the papery valves hirsute with widely spreading, lustrous hairs minutely bulbous-

thickened at base LVII (ii). Subsect. *Desperati*

1. Pod ascending (humistrate), straight to lunately incurved, either dorsiventrally compressed (and unilocular) but then of leathery texture, or trigonous (when papery and semibi- or bilocular), but the valves in any case strigulose with short, filiform, appressed hairs LVII (i). Subsect. *Naturitenses*

LVII (i). Subsectio NATURITENSES

Pod ascending, humistrate, from procumbent peduncles, the valves (leathery or papery, not or deeply inflexed) strigulose.—Spp. 3, all very local, of southwestern Colorado, southeastern Utah, and adjoining northern Arizona.

ASTRAGALUS sect. DESPERATI subsect. NATURITENSES, subsect. nov., a *Desperatis* genuinis legumine adscendenti humistrato striguloso (nec deflexo hirsuto) absimiles. Legumen variat dorsiventraliter et triquetrum compressum, uni-, semibi- et complete biloculare.—Sp. typica: *A. naturitensis* Pays.

Key to the Species of Subsect. Naturitenses

1. Stipules free; *calyx-tube* 3.7–6.7 mm. long; *petals* pink-purple or whitish tipped with purple, the keel 7.8–12.4 mm. long, its blades rounded at apex; *pod* either leathery or subbilocular; *ovules* 16–31 (2)
2. Pod narrowly ellipsoid, 13–22 mm. long, 4–6 mm. in diameter, dorsiventrally compressed (sometimes obscurely trigonous in the proximal $\frac{2}{3}$), shallowly and openly sulcate dorsally, the valves leathery, not or very obscurely inflexed, the septum 0–0.5 mm. wide; s.-w. Colorado (Montrose and Montezuma Counties) 228. *A. naturitensis*
2. Pod linear-oblong or -lanceolate in profile, compressed-triangular, the narrow dorsal face deeply sulcate, the valves papery and inflexed as a complete or sub-complete septum 1–2 mm. wide; s.-e. Utah (San Juan County) and adjoining Arizona (n. Navajo County) 229. *A. monumentalis*
1. Stipules (at least the lowest) connate; *calyx-tube* 3–3.5 mm. long; *petals* ochroleucous veined with dull brownish-purple, the keel 7–7.5 mm. long, its blades contracted into a narrowly deltoid apex; *pod* trigonously compressed, the valves papery, the septum narrow or obscure (0.2–0.6 mm. wide); *ovules* 8–10; Mesa Verde, Montezuma County, Colorado 230. *A. deterior*

228. ASTRAGALUS NATURITENSIS

Low, subacaulescent, closely tufted, with a pluricipital, woody taproot and shortly forking, suffruticulose caudex, loosely strigulose nearly throughout with appressed or narrowly ascending, straight hairs up to 0.45–0.7 mm. long, the herbage cinereous, the leaflets often medially glabrescent above; *stems* 0–3 cm. long, the internodes mostly concealed by stipules, none over 0.5 cm. long; *stipules* submembranous becoming papery-scarious and pallid, broadly ovate or ovate-acuminate, several-nerved, 2–7 mm. long, amplexicaul and mostly broader than the stem, the contrapetiolar margins sometimes in contact but not united, glabrescent dorsally; *leaves* subradical, 1.5–6 (7) cm. long, with rather firm petiole and 9–15 (17) elliptic-obovate, oval, or oblanceolate, obtuse or subacute, thick-textured, loosely folded leaflets 2–8 mm. long; *peduncles* rather stout, 1–6.5 cm. long, ascending at anthesis, reclinate in fruit; *racemes* shortly but loosely (3) 4–8 (11)-flowered, the axis slightly elongating, 0.5–2.5 cm. long in fruit; *bracts* membranous, ovate-acuminate, 1.5–4 mm. long; *pedicels* ascending, at anthesis 0.7–1.2 mm., in fruit thickened, 1–1.8 mm. long; *bracteoles* commonly 0, rarely 2 and up to 1 mm. long; *calyx* 5.2–7.4 mm. long, strigulose with white or white mixed with some black hairs, the slightly oblique disc 1–1.3 mm. deep, the cylindric to deeply campanulate, purplish tube 4.2–6.2 mm. long, 2.2–3.2 mm. in diameter, the triangular-subulate teeth 0.9–1.4 mm. long; *petals* bicolored, the banner whitish or suffused or lined with lilac, the wing- and keel-tips purple; *banner* recurved through $\pm 40^\circ$, rhombic-obovate-cuneate, shallowly notched, 13–15.5 mm. long, 7–8.4 mm. wide; *wings* 12–13.8 mm. long, the claws 5.5–7.4 mm., the narrowly oblong or oblong-elliptic, obtuse, straight or slightly incurved

blades 7–8 mm. long, 2.1–2.5 mm. wide; *keel* 10–12.5 mm. long, the claws 5.5–7.4 mm., the half-obovate blades 5.5–6 mm. long, 2.5–2.9 mm. wide, incurved through 85–95° to the rounded apex; *anthers* 0.6–0.7 mm. long; *pod* ascending (humistrate), borne on a slightly elevated receptacle or incipient gynophore up to 0.8 mm. long, the body obliquely ellipsoid, 1.3–2.2 cm. long, 4–6 mm. in diameter, gently incurved, cuneate at base, contracted distally into a short, triangular-acuminate, cuspidate beak, elsewhere dorsiventrally compressed and sometimes obscurely triquetrous in the lower $\frac{3}{4}$, carinate by the prominent (but sometimes depressed) ventral suture, the lateral angles rounded, shallowly and openly sulcate dorsally, the thinly fleshy, green but nearly always purple-mottled, strigulose valves becoming leathery, stramineous, transversely reticulate, not inflexed, or if so the septum obscure and not over 0.5 mm. wide; *dehiscence* apical and ultimately through the length of the ventral suture; *ovules* 22–31; *seeds* brown or olivaceous, often purple-speckled, somewhat pitted, 1.7–2.3 mm. long.—Collections: 7 (iii); representative: *Payson* 993 (MO); *Ripley & Barneby* 8405 (CAS, NY, RSA); *Barneby* 12,796 (CAS, NY, POM, UTC, US), 13,059 (CAS, NY, RSA).

Sandstone ledges and crevices of rimrock pavement along canyons, with juniper and piñon, 5400–6200 feet, local and apparently rare, known only from the valleys of the Dolores River and McElmo Creek in Montrose and Montezuma Counties, Colorado.—Map No. 84.—April to early June.

ASTRAGALUS NATURITENSIS (of Naturita, Colorado) Pays. in Bot. Gaz. 60: 377. 1915.—“Collected on dry rocky mesas near Naturita, alt. 5400 ft.; May 27, 1914 (*Payson* 360).”—Holotypus, RM!—*A. naturitensis* var. *typicus* Barneby in Leaflet West. Bot. 4: 51. 1948.

Astragalus arietinus var. *stipularis* (with large stipules) Jones in Proc. Calif. Acad. Sci. II, 5: 654. 1895.—“Miss Eastwood, along McElmo Creek, S.W. Colorado, June, 1892.”—Holotypus, POM! isotypus (a sterile fragment), NY!—*A. stipularis* Jones, op. cit., p. 655, nom. provis., & Rev. Astrag., Pl. 54 & Index to Plates. 1923, nom. nud. *Xylophacos stipularis* (Jones) Rydb., Fl. Rocky Mts. 504. 1927, quoad nom., non descr.

The Naturita milk-vetch was first discovered by Alice Eastwood along McElmo Creek below Cortez, but her specimens, scanty and lacking flowers, were really insufficient for description. They were interpreted by Jones as representing a variety of *A. arietinus* (our *A. cibarius*), an entirely different type of emmenoboid astragalus, and later were referred to the sympatric but very different *A. desperatus*, a species with papery, loosely hirsute pod of broader and shorter outline, a shallower calyx-tube, and smaller flowers. The parti-colored flowers, whitish or faintly lilac-tinged except for the purple (described by Payson as “red”) wing- and keel-tips, are quietly attractive.

229. *ASTRAGALUS MONUMENTALIS*

Dwarf, tufted, subcaulescent, with an ultimately woody taproot (but sometimes flowering the first season) and a shortly but closely forking caudex with branches up to 6 cm. long (but mostly less), strigulose nearly throughout with straight or nearly straight, appressed and narrowly ascending hairs up to 0.35–0.7 mm. long, the stems cinereous or canescent, the herbage cinereous or greenish, the leaflets sometimes medially glabrescent or almost glabrous above; *stems* several, 0.5–3.5 cm. long, the internodes either concealed by stipules or, if exposed, only 2–5 mm. long; *stipules* membranous, becoming papery and stramineous, broadly ovate or triangular, 2–5 mm. long, often broader than the stem, some (or at least the lowest) decurrent around $\frac{3}{4}$ to the whole stem’s circumference but not connate; *leaves* 1.5–6 (7) cm. long, with slender, wiry, subpersistent petiole and (5) 9–17 (21) oval-obovate, oblanceolate, or narrowly oblong-elliptic, obtuse, acute, or emarginate, mostly folded and backwardly falcate, in age readily deciduous leaflets 2–9 mm. long; *peduncles* 1.5–5 (6) cm. long, ascending at anthesis, prostrate and radiating in fruit; *racemes* loosely but shortly 3–9-flowered, the axis little elongating, 0.5–3.2 cm. long in fruit; *bracts* mem-

branous, broadly ovate or lanceolate, 1.5–5 mm. long; *pedicels* ascending, straight, at anthesis 0.8–1.2 mm., in fruit a trifle thickened and 1.3–2.2 mm. long; *bracteoles* 0; *calyx* 4.7–8.4 mm. long, strigulose with white or mixed black and white hairs, the slightly oblique disc 0.7–1.5 mm. deep, the membranous, deeply campanulate or cylindric, often purplish tube 3.7–6.7 mm. long, 2–3.1 mm. in diameter, the firm, subulate teeth 1–2 mm. long; *petals* pink-purple, drying violet or bluish, the banner striate with deeper pink veins; *banner* recurved through $\pm 45^\circ$, 8.5–14.8 mm. long, the broadly long-cuneate claw expanded into an ovate, notched blade 6–8.5 mm. wide; *wings* 8.1–13.3 mm. long, the claws 3.9–6.9 mm., the lunately oblong-obovate or broadly oblanceolate to narrowly elliptic and straight, obtuse blades 5.4–8.5 mm. long, 2.1–2.7 mm. wide; *keel* 7.8–12.4 mm. long, the claws 4–6.7 mm., the half-obovate blades 5.3–6.6 mm. long, 2.3–2.7 mm. wide, abruptly incurved through $90-100^\circ$ to the blunt, deltoid apex; *anthers* 0.4–0.6 mm. long; *pod* ascending (humistrate), disjointing from the scarcely elevated receptacle or incipient gynophore up to 0.5 mm. long, lunately linear-lanceolate in profile, incurved through $1/10-1/4$ circle, (1.5) 1.8–3 cm. long, 2.6–4.4 mm. in diameter, rounded or broadly cuneate at base, abruptly acute or acuminate and cuspidate at apex, compressed-triquetrous, the lateral faces broad and flat, the narrower dorsal face deeply sulcate, the ventral suture salient, the lateral angles narrow but obtuse, the thinly fleshy, green to brownish- or purple-mottled, strigulose valves becoming papery, stramineous, finely reticulate, inflexed as a complete or nearly complete septum 1–2 mm. wide; *dehiscence* both apical and basal, after falling; *ovules* 16–28; *seeds* brown, purple-dotted, irregularly pitted, lustrous, 1.9–2.8 mm. long.—Collections: 7 (iv); representative: *Peebles & Fulton 11,928* (US); *Barneby 12,783, 13,084, 13,106* (CAS, NY, RSA); *B. F. Harrison 5922* (BRY).

Sandy ledges and crevices of rock pavement, sometimes seeding down into draws and washes, on white sandstones of the Navajo series, (4000) 4500–6150 feet, local and rare, canyons of the Colorado and lower San Juan Rivers in San Juan County, Utah, and northern Navajo County, Arizona.—Map No. 84.—April to June.

ASTRAGALUS MONUMENTALIS (of Monument Valley) Barneby in Leaf. West. Bot. 7: 35. 1953.—“UTAH: White Canyon, 25 miles north of Hite, Garfield [in reality San Juan] County, May 18, 1950, *B. F. Harrison 11,595*.”—Holotypus, US! isotypus, BRY!

In the spring of 1955 and again in 1961, I had the rare fortune to see living plants of *A. monumentalis* (in White Canyon and Monument Valley) and *A. naturitensis* (near Naturita and Cortez) within the space of a few days. The likeness in general facies and in habitat is extraordinarily close, and the two species vary, up to the fruit, in almost precisely similar ways. The petals of *A. monumentalis* are concolorous and pink-purple, whereas the banner of *A. naturitensis* is whitish or faintly lavender-tinged, thus contrasting with the purple tips of the inner pairs of petals; but this difference may prove unreliable. The pods are so different in their compression and in the development of a septum that the two species would surely have been referred by Rydberg to different genera. The differences, however, lose much systematic importance when seen in the light of other uni- and bilocular twins, such as *A. tephrodes* and *A. feensis* in sect. *Argophylli*, *A. Geyeri* and its var. *triquetrus* in sect. *Inflati*, or the extraordinary *A. diaphanus* in which a substantially equivalent variation is found in different forms of the same species. The Monument Valley milk-vetch is probably derived from *A. naturitensis* and is one of our most highly specialized and presumably recently evolved astragali.

230. *ASTRAGALUS DETERIOR*

Low, slender, subcaulescent or shortly caulescent, taprooted perennial, strigulose-cinereous with narrowly ascending, straight hairs up to about 0.7 mm. long, the leaflets sometimes medially glabrescent above; *stems* arising together from the root-crown or from a shortly forking caudex, usually few, 0.5–3 (7) cm. long,

when developed prostrate, but the internodes always short, barely twice longer than the stipules; *stipules* ovate, papery-scarious, 1–4 mm. long, amplexicaul, at least some of them broader than the stem and shortly connate into a loose, sometimes tardily ruptured sheath; *leaves* 2–10 cm. long, slender-petioled, with 11–15 (17) linear-elliptic and acute or oblanceolate and obtuse, commonly folded leaflets 3–10 mm. long, all readily deciduous in age from the wiry, subpersistent petioles; *peduncles* ascending at anthesis, reclinate in fruit, (1.5) 2.5–8 cm. long; *racemes* loosely 2–5-flowered, the flowers ascending, the axis little elongating, 0.5–2 cm. long in fruit; *bracts* papery-scarious, ovate, 1.5–2.5 mm. long; *pedicels* at anthesis 1.5 mm., in fruit 2 mm. long; *calyx* 5–5.5 mm. long, strigulose with black and white hairs, the subsymmetric disc 0.5 mm. deep, the submembranous, purplish tube 3–3.5 mm. long, 2–2.3 mm. in diameter, the subulate teeth 1.5–2 mm. long; *petals* ochroleucous, the keel-tip spotted with dull purple; *banner* recurved through $\pm 45^\circ$, ovate-cuneate, 9.5–11 mm. long, 5–6 mm. wide; *wings* 8–9 mm. long, the claws ± 3.5 mm., the narrowly oblong, gently incurved blades ± 5.5 –6.5 mm. long, 2 mm. wide; *keel* 7–7.5 mm. long, the claws 2.5–3.3 mm., the blades 3.8–4.5 mm. long, 2.2–2.5 mm. wide, incurved through $\pm 90^\circ$ to the rather narrowly deltoid apex; *anthers* 0.45 mm. long; *pod* ascending (humistrate), disjointing from an obscure gynophore up to 1 mm. long, narrowly oblong in profile, gently incurved, 1.2–2 cm. long, 3.5–5 mm. in diameter, below the short, deltoid, laterally flattened beak subtrigonously compressed, carinate ventrally by the salient suture, shallowly grooved dorsally, the lateral angles rounded, the thin, red-mottled, sparsely strigulose valves becoming papery, delicately reticulate, inflexed as an inconspicuous partial septum 0.2–0.6 mm. wide; *dehiscence* apical, after falling; *ovules* 8–10; *seeds* mahogany-brown, somewhat angular and pitted, 2–2.6 mm. long.—Collections: 4 (iii); representative, *Ripley & Barneby* 8397 (RSA); *Barneby* 13,068 (NY, RSA); *J. T. Howell* 24,756 (CAS).

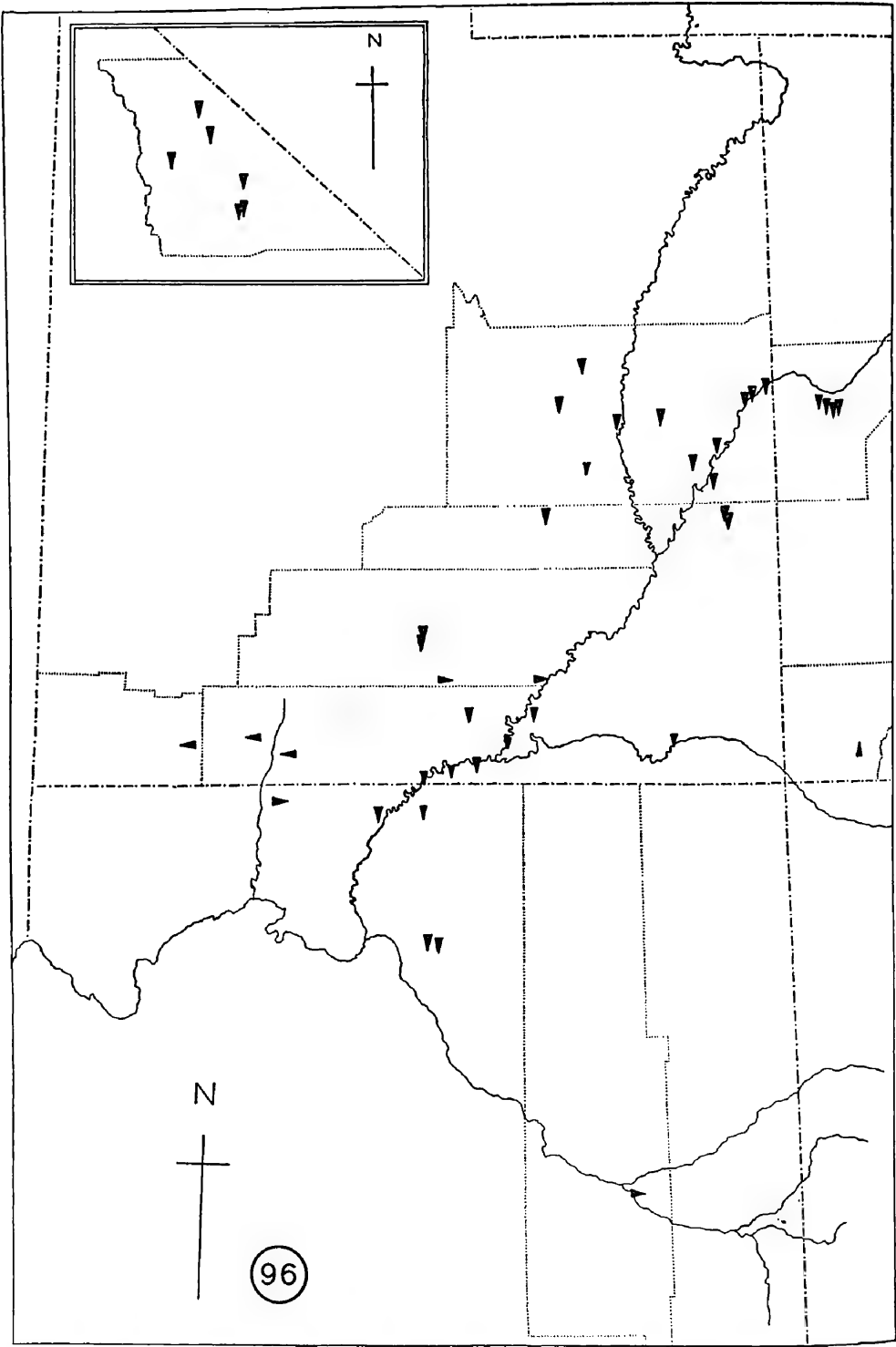
Ledges of sandstone cliffs, sand-filled depressions of flat or shelving rock, seeding down to loose sandy talus, 6700–6900 feet, with juniper and piñon, known only from the south end of Mesa Verde, near the aboriginal dwellings and cliff-palaces, Montezuma County, Colorado.—Map No. 96.—May and June.

ASTRAGALUS DETERIOR (Barneby) Barneby in Leaf. West. Bot. 7: 36. 1953, based on *A. naturitensis* var. *deterior* (meaner, by contrast with the genuine *Naturita* milk-vetch) Barneby in op. cit. 5: 88. 1948.—“COLORADO: . . . on the south rim of Mesa Verde, and on detrital slopes beneath the Cliff Palace, Montezuma Co., 21 May 1943, fl. & fr., *Ripley & Barneby* No. 5359 . . .”—Holotypus, CAS! isotypi, GH, K, NY, POM, RSA!

The cliff-palace milk-vetch, *A. deterior*, is an inconspicuous little plant, known at present from an area on Mesa Verde embracing a few acres at most, but it is to be looked for on the higher sandstone mesas elsewhere in the Four Corners country. Diagnostic features to be looked for are the very short or obsolete stems, the racemes of some two to five small, loosely, ascending, dingily straw-colored flowers of broad and short outline conforming to the shallow-campanulate calyx-tube, and more especially the slenderly fusiform, gently incurved pod of papery texture, red-mottled and thinly strigulose, bluntly triangular in cross-section and narrowly septiferous within. The species was at first mistaken for *A. naturitensis* (cf. Barneby in Leaf. West. Bot. 4: 51. Pl. opp. p. 56, figs. 16, 17. 1944); but it differs from that species, as now known from much better material, in its smaller, ochroleucous flowers, connate stipules, and narrower pod of thinner texture elevated on a distinctly developed gynophore. The fruit more nearly resembles that of *A. monumentalis* in texture and mode of compression, but the septum is narrower and the flowers are smaller and of a different color. The united stipules, narrowly deltoid keel-tip, and few ovules serve to separate *A. deterior* decisively from either of its close relatives.

LVII (ii). Subsectio DESPERATI

Pod declined or deflexed (from either ascending or procumbent peduncles), the papery valves hirsute with widely spreading, minutely bulbous-based hairs.—Sp. 1, range of the section.



Map No. 96. Southern Utah, northern Arizona, and part of western Colorado. Range of *A. desperatus*: $\blacktriangle$ var. *desperatus*; and $\blacklozenge$ var. *conspicua*; of $\blacksquare$ *A. deterior*; and of $\bullet$ *A. striatiflorus*. Inset, upper left, Inyo County, California. Range of *A. panamintensis*.

ASTRAGALUS sect. DESPERATI Barneby, ut supra descripta, sens. str.—Sp. unica: *A. desperatus* Jones.

231. ASTRAGALUS DESPERATUS

Dwarf, tufted, subcaulescent and shortly caulescent perennial, with woody taproot and at length shortly forking suffruticulose caudex often beset with a thatch of wiry, persistent but not spinose petioles, strigulose, strigose-hirsutulous, or loosely strigose with straight or largely straight and appressed or often some (especially toward the inflorescence, and late in the season elsewhere) or even mostly ascending hairs up to 0.5–0.95 (1.3) mm. long, the herbage greenish-cinereous or silvery-canescens, the leaflets pubescent on both sides but thinly so or medially glabrescent above; *stems* almost 0 or up to 3 (8) cm. long, when developed prostrate, the internodes often all concealed by loosely imbricated stipules, even when developed short, up to 6 (8) mm. long, mostly less; *stipules* submembranous early becoming papery-scarious, ovate to broadly lanceolate, (1.5) 2–7 mm. long, semi- or the early ones fully amplexicaul, the lowest sometimes very shortly and obscurely connate (but less connate than adnate); *leaves* (1) 1.5–7 (9) cm. long, slender-petioled, with (3) 7–15 (17) well-separated or rarely crowded, oblanceolate, obovate, or elliptic, obtuse or subacute, commonly folded leaflets 2–11 (13) mm. long, all readily deciduous when dry; *peduncles* usually quite slender, erect and ascending at anthesis, reclinate in fruit, 1–9 cm. long, much shorter, equaling, or a little longer than the leaf; *racemes* loosely but sometimes very shortly (3) 4–14-flowered, the flowers at first ascending, spreading or declined in age, the axis scarcely or considerably elongating, 0.4–7 cm. long in fruit; *bracts* papery-membranous, ovate-acuminate or lanceolate, (1) 1.5–5 mm. long; *pedicels* at anthesis ascending, 0.5–1 (1.2) mm. long, in fruit arched outward, thickened but ultimately disjointing, 0.5–1.4 (2) mm. long; *bracteoles* usually 0, rarely 1 or 2; *calyx* 3.5–9.4 mm. long, loosely strigulose with white and often some black hairs, the subsymmetric disc 0.5–1.4 mm. deep, the membranous, purplish tube varying from campanulate to cylindric, the subulate teeth 0.8–2.4 mm. long; *petals* pink-purple or lilac-pink, drying violet or bluish, the wing-tips sometimes pallid or white; *banner* recurved through $\pm 45^\circ$, obovate-cuneate or broadly oblanceolate, shallowly notched, 7.4–14.5 mm. long; *wings* a little shorter, the straight or slightly incurved blades obtuse or emarginate at apex; *keel* 5.9–12.5 mm. long, the half-obovate blades incurved through $90\text{--}115^\circ$ to the rounded apex; *anthers* 0.4–0.7 mm. long; *pod* strongly declined or deflexed (but the tip often incurved to erect), sessile on and readily disjointing from a conical receptacle or incipient gynophore up to 1.2 mm. long, obliquely ovoid, oblong-, or lance-ellipsoid, lunately to very strongly incurved through $1/10\text{--}3/4$, rarely an almost complete circle, 6–19 mm. long, 3–6 mm. in diameter, obtuse or retuse at base, contracted distally into a cuneate to broadly deltoid, laterally compressed, commonly incurved beak, elsewhere more or less strongly dorsiventrally compressed, carinate ventrally by the thin, prominent (but proximally often depressed) suture, openly sulcate dorsally, the thin, green but nearly always red-mottled or -spotted valves becoming papery, stramineous, delicately cross-reticulate, hirsute with lustrous, loosely ascending or horizontal, more or less twisted hairs seated on a minute bulbous thickening, not inflexed or inflexed as a very narrow partial septum up to 1 mm. wide; *dehiscence* apical and downward through the ventral suture, the beak widely gaping; *ovules* 16–28, commonly 18–24; *seeds* brown or greenish, often purple-speckled, pitted or wrinkled but somewhat lustrous, 2–2.9 mm. long.

The rimrock milk-vetch, *A. desperatus*, is one of quite few astragali in which a mutation has occurred involving the size and relative proportions of the calyx and petals, with scarcely any change readily apparent in other organs. The easily distinguished varieties are found in

identical environments and are not mutually exclusive in range, phenomena again unusual in the genus.

Key to the Varieties of *A. desperatus*

1. Calyx 3.5–5.5 (6) mm. long, the campanulate tube (2.5) 2.7–4 mm. long, (1.7) 2–2.8 mm. in diameter; *keel* 5.9–7.7 (8) mm. long; *racemes* nearly always elongating, the axis (0.5) 1.5–7 cm. long in fruit; relatively common in Utah s. of Tavaputs Escarpment and along Grand River in w. Colorado, s. to the Moenkopi in n. Arizona 231a. var. *desperatus*
1. Calyx (6.5) 6.9–9.4 mm. long, the cylindric tube (5) 5.3–7 mm. long, 1.3–3.1 mm. in diameter; *keel* 9.8–12.5 mm. long; *raceme* not or little elongating, the axis 0.4–2 cm. long; rare and local, n. Arizona and adjoining Utah 231b. var. *conspicuosus*

231a. *ASTRAGALUS DESPERATUS* var. *DESPERATUS*

Flowers small, the banner 7.4–10.5 (11) mm. long, 5–7.5 mm. wide; *wings* 6.7–9.5 mm. long, the claws 2.8–4 mm., the blades 5–6.6 mm. long, 2.2–2.6 mm. wide; *keel-claws* 2.8–4 mm., the blades 3.5–4.5 (5) mm. long, 2.1–2.5 mm. wide; *anthers* 0.4–0.5 mm. long; *pod* 6–15 mm. long, 3–6 mm. in diameter.—Collections: 36 (xii); representative: *Rydberg & Garrett* 8428 (NY); *Holmgren & Tillett* 9445 (NY, RSA); *McVaugh* 14,572 (CAS, NY); *Wm. A. Weber* 3757 (TEX, WS); *Barneby* 12,668, 12,759 (CAS, RSA), 13,098, 13,145 (CAS, NY, RSA).

Rock ledges, crevices of rimrock pavement, and sandy detritus on boulder-strewn slopes under cliffs or at the foot of buttes, 4100–5600 feet, with piñon and juniper, on red or white sandstone, locally plentiful in the Colorado Basin south of Tavaputs Escarpment from near Grand Junction, Colorado, west to the San Rafael Swell, Utah, south, but becoming less common, to the foothills of the Kaibab and Moenkopi Wash in Coconino County, Arizona.—Map No. 96.—April to June.

ASTRAGALUS DESPERATUS (despairing, in reference to Jones's state of mind in searching for an epithet unoccupied in *Astragalus*: an exaggerated dilemma) Jones in *Zoë* 2: 243. 1891. —“This grows in sand along or near Grand River, in eastern Utah. Collected May 2, 1890.”—Holotypus, collected by Jones at Cisco, Grand County, Utah, POM! isotypi, GH, RM, TEX, UC, US, WS!—*Tium desperatum* (Jones) Rydb. in *Bull. Torr. Club* 32: 660. 1905. *Batidophaca desperata* (Jones) Rydb. in *N. Amer. Fl.* 24: 319. 1929. *Astragalus desperatus* var. *typicus* Barneby in *Leaf. West. Bot.* 5: 87. 1948.

Astragalus desperatus var. *petrophilus* (rock-loving) Jones, *Rev. Astrag.* 204, Pl. 45. 1923. —“... in the San Rafael Swell region, Utah...”—Holotypus, collected by Jones in the San Rafael Swell, May 17, 1914, POM! isotypus, NY!—*Batidophaca petrophila* (Jones) Rydb. in *N. Amer. Fl.* 24: 320. 1929.

The common form of the rimrock milk-vetch, var. *desperatus*, is a neat little plant, notable for its tufted growth-habit, slender, wiry petioles from which the leaflets disjoint readily when dry, subscapose peduncles, and especially the small, deflexed, commonly much incurved, nearly always gaily mottled pod of papery texture beset with long, spreading, lustrous hairs minutely but always perceptibly enlarged at base. The small flowers are commonly bicolored, the white or pallid wing-tips contrasting with a purple banner and keel. The species is very characteristic of the sandstone butte and badland country of the Colorado Basin. It is usually found where its eventually woody taproot can strike down into a crevice of sandstone bedrock, thus often on rock pavement or on detrital slopes under cliffs with only a thin mantle of clay or wind-blown sand masking the rocky nature of the subsurface materials. The flowers vary somewhat in size; there is a series of variants connecting the small-flowered extreme exemplified by the typus of var. *petrophilus* with a normal or average state.

Over much of its range in Arizona and extreme southern Utah, var. *desperatus* is sympatric with *A. sabulonum*, a monocarpic species found on dunes and sandy valley floors where the rimrock milk-vetch cannot be expected to occur. Similar in many technical features, they have often been confused, but *A. sabulonum* is distinguished by its developed stems (short only in obvious seedlings), villous herbaceous, fewer (mostly 2–5) and slightly smaller flowers, and by the pod which, although similar in shape and structure, is more stiffly papery and merely hirsutulous (not lustrously hirsute) with much shorter hairs. Note must be made of *A. pubentissimus*, of which the papery-membranous, lustrously hirsute pod is similar to that of *A. des-*

peratus in orientation and structure; this species extends rarely south of Tavaputs Escarpment just into the range of *A. desperatus*. It is a coarse annual or short-lived perennial resembling *A. sabulonum* in its developed stems and type of vesture, and differs further in having a pod on the average longer (1.2–2 cm.) and fewer-ovulate, and beset with hairs not at all thickened at base.

231b. ASTRAGALUS DESPERATUS var. CONSPECTUS

Flowers longer and narrower than in var. *desperatus*, the banner 12.2–14.5 mm. long, 6–7.5 mm. wide; wings 11.5–13.4 mm. long, the claws 5.5–6.8 mm., the blades 6.7–8.1 mm. long, 2–2.6 mm. wide; keel-claws 5.5–7.5 mm., the blades 4.8–6. mm. long, 2.3–2.8 mm. wide; anthers 0.45–0.7 mm. long; pod 1.2–1.9 cm. long, 5–6 mm. in diameter.—Collections: 3 (ii); representative: *B. F. Harrison 11,706* (BRY, US); *Barneby 12,676* (CAS, RSA).

Crevices of sandstone rimrock along canyons and on rock ledges of sandstone buttes and knolls, about 5000–5100 feet, apparently local, known only from three stations in the Colorado Basin: near Holbrook, Navajo County, and Kanab Valley, Coconino County, Arizona, and in the Little Rockies, southeastern Garfield County, Utah.—Map No. 96.—April to June.

ASTRAGALUS DESPERATUS var. CONSPECTUS (remarkable) Barneby in Leaf. West. Bot. 5: 87. 1948.—“ARIZONA: . . . along the Little Colorado River, 4 miles east of Holbrook, Navajo Co., alt. 5000 ft., 1 June, 1947 . . . Ripley & Barneby No. 8451.”—Holotypus, CAS! isotypus RSA!

The var. *conspectus* may be recognized by its shortly racemose flowers, which are not only longer but proportionately narrower than in var. *desperatus*, by the cylindric calyx-tube, and uniformly pink-purple petals. At anthesis it might easily be taken for some member of sect. *Argophylli*, but the papery-membranous texture of the pod would be anomalous and the comparatively few ovules unusual in that section. The known stations of the variety, in two of which only about a dozen plants were seen, lie widely distant from each other, and further collections will be awaited with interest.

LVIII. Sectio LAYNEANI

Caulescent perennials, with subterranean root-crown giving rise to slender, horizontal rhizomes; *vesture* basifixed, hirsute; *stipules* free; *leaves* imparipinnate, the leaflets mostly 13–21; *flowers* loosely racemose, ascending or spreading, sometimes a trifle declined, of moderate size, the banner 12.5–18 mm. long; *pedicels* thickened in age, persistent; *calyx-tube* deeply campanulate; *petals* whitish, lavender- or purple-tipped, regularly but not strongly graduated, the keel obtuse; *pod* ascending, incurved-ascending, or more rarely declined, sessile, readily deciduous, obliquely lance-acuminate or linear-elliptic in profile, lunately or hamately incurved, or annular, compressed-triquetrous or obcompressed from the middle downward, the fleshy valves becoming leathery, strongly inflexed; *dehiscence* apical, after falling; *ovules* 26–36.—Sp. 1, xerophyte, of the Mohave Desert in southeastern California, southern Nevada, and northwestern Arizona.

ASTRAGALUS sect. LAYNEANI, sect. nov., affinitatis subdubiae, *Argophyllis* forsan maxime affines sed inter *Astragalos* piptolobos grandifloros caulibus subsolitariis e caudicis subterranei ramis gracilibus elongatis emissis et legumine angusto elongato subbiloculari insignes.—Sp. unica: *A. Layneae* Greene.

The Layne milk-vetch, the only species on the Mohave Desert characterized by an extensive elaboration of the subterranean parts, is an isolated monotype of uncertain affinity. It seems to be so greatly modified that direct clues to its relationships in the genus have been lost or at least effectively masked. The monotypic section is introduced here because *A. Layneae* agrees in several features of a certain importance with *A. Tidestromii* of sect. *Argophylli*, although it differs from all members of that section by its rhizomatous habit of growth and from the majority of them further by its bilocular fruit. It has been suggested else-

where that *A. Tidestromii* may have arisen through hybridization between *A. Layneae* and *A. (Argophylli) amphioxys*. Whether this is truly so or not, *A. Tidestromii* serves as the only plausible connection between *A. Layneae* and another definite group.

The conventional and hitherto unchallenged view of *A. Layneae* as a close relative of *A. malacus* is surely incorrect. This misconception arose from the superficial similarity in the hirsute pubescence and bilocular pod and was nourished by reports of supposedly intermediate specimens linking the two species which happen to be vicariant in range. The root-crown of *A. malacus* is superficial and determinate; its pod is shortly stipitate, securely attached to the receptacle, and deciduous with the disjoining pedicels. By contrast the fruit of the Layne milk-vetch is truly sessile and disjoints from the receptacle upon ripening, leaving the pedicel and marcescent calyx attached to the raceme axis. Jones at one time reduced *A. Layneae* to the rank of variety under *A. malacus*, after study of specimens collected at Inyo, California, by Brandegee, in 1892, which he believed intermediate between the two species. This material was lost in the fire of 1906, and may have been an accidental mixture of genuine *A. malacus* and *A. Layneae*; in any case, we have no modern evidence of passage between these sharply marked species. In later years, when Jones had come to know *A. Layneae* better, he reacknowledged it as distinct. It is surmised that the "rare hybrid *A. malacus* $\times$ *Layneae*," described in the Revision (1923, p. 228) as combining the flowers of *A. Layneae* with pods "varying toward those of *A. amphioxys*," was based on a memory or a reinterpretation of Brandegee's plants.

232. ASTRAGALUS LAYNEAE

Low and rather coarse, with a deeply buried, vertical or oblique, woody primary root giving rise to slender, horizontal, indefinitely elongating, subterranean caudex-branches (rhizomes) beset with small, globose, pubescent buds (most of them inhibited but at irregular intervals along the rhizomes developing an independent root-system and aerial stems), above ground densely gray-hirsute with rather stiff, spreading or ascending, straight, incurved, or somewhat sinuous hairs up to 1–2 mm. long, the vesture sometimes composed largely of shorter, incurved hairs but some long ones always present; *stems* solitary or few together, slender, simple, and subterranean for a space of 1–7 cm., becoming abruptly stouter on emergence, branched or spurred at the lowest, approximate aerial nodes, the part above ground 2.5–16 cm. long, erect or nearly so, composed of several short, flexuous or zigzag internodes, the whole shorter than the longest raceme and peduncle together; *stipules* membranous, or the upper, spreading or deflexed ones thinly herbaceous distally, 3–10 (12) mm. long, broadly ovate-triangular to lance-acuminate, semi- or almost fully amplexicaul but free; *leaves* (4) 6–16 cm. long, all petioled but the upper ones shortly so, with (11) 13–21 (23) ovate, obovate, rhombic-ovate, obovate-cuneate, broadly elliptic, or suborbicular, obtuse or shallowly retuse, flat or loosely folded leaflets 5–18 (23) mm. long, dorsally carinate in age by the midrib; *peduncles* stout, at anthesis erect, in age often divaricate or weighed down by the fruits, 4.5–10 (14) cm. long; *racemes* loosely (12) 15–45-flowered, the flowers at first ascending, becoming horizontal or a little declined, the axis early elongating, (3) 5–20 (30) cm. long in fruit; *bracts* membranous, pallid, triangular-acuminate, lanceolate, or linear-elliptic, 2.5–6 mm. long, ultimately spreading or recurved; *pedicels* ascending, straight or a little arched outward, at anthesis 0.6–1.2 mm., in fruit 1.5–2.8 mm. long; *bracteoles* 2, usually conspicuous; *calyx* 6–8.8 mm. long, densely hirsute or hirsutulous with black or largely black hairs, the oblique disc (0.8) 1–2 mm. deep, the deeply or sometimes broadly campanulate tube 5–7.5 mm. long, (2.6) 3–4 (4.5) mm. in diameter, the obtusely deltoid or subulate teeth 1–2 mm. long; *petals* whitish with deep purple or lavender wing- and keel-tips, the banner sometimes also distally suffused or broadly margined with dull purple; *banner* gently recurved through $\pm 50^\circ$, broadly oblanceolate, rhombic-oblanceolate, or -spatulate, 12.5–17.5 (18) mm. long, 6.6–9.5 (10.2) mm. wide; *wings* as long or only 1 (1.5) mm. shorter, 11.8–16.5 (17.5) mm. long, the claws 5.4–9.5 (10) mm., the narrowly oblong, obtuse or obliquely truncate, nearly straight blades 6.7–9.5 mm. long, 1.9–2.7 (3) mm.

wide; *keel* 10.4–15.4 (16.5) mm. long, the claws 5.2–9 (10) mm., the lunate or half-obovate blades 5.3–7.1 mm. long, (2.3) 2.5–3.5 mm. wide, gently incurved through 95–100° to the bluntly triangular apex; *anthers* (0.4) 0.45–0.65 (0.7) mm. long; *pod* loosely ascending, incurved-ascending, spreading, or rarely declined, sessile on and readily disjoining from the conical receptacle, very obliquely linear-ellipsoid, (2) 3–6.5 cm. long, 3.5–8 mm. in diameter, cuneate or acuminate, laterally compressed, unilocular beak, either uniformly incurved into a crescent, or more commonly almost straight proximally and thereafter abruptly incurved or hooked through $\frac{1}{3}$ to almost a full circle, the body compressed-triquetrous or (when broad) obcompressed from the middle downward and triquetrous up to the beak, with acute ventral and rounded lateral angles, openly or sometimes narrowly sulcate dorsally, the fleshy, green or sometimes purplish, commonly red-mottled valves becoming leathery, reticulate or somewhat rugulose on the angles, villous-hirsute (hirsutulous) with straight or sinuous hairs, inflexed as a partial or complete septum 1–3.5 mm. wide; *dehiscence* tardy, the beak gaping; *seeds* pale brown, sometimes purple-speckled, pitted or wrinkled, often prismatically angled or quadrate through crowding, 2.8–4.7 mm. long.—Collections: 53 (vi); representative: *Maguire & Holmgren* 25,223 (NY, RSA, UTC); *Eastwood & Howell* 9508 (CAS, WS); *C. B. Wolf* 6597 (CAS, WS), 10,163, 10,292 (CAS, TEX); *Barneby* 12,322 (CAS, NY, RSA).

Sandy flats, washes and gentle slopes or outwash fans in the foothills of desert mountains, 1500–5100 feet, with *Larrea*, bud-sage, or rarely in sagebrush, on granite or basalt, apparently calcifuge, locally abundant and sometimes forming extensive colonies, common and well-distributed over the Mohave Desert in southeastern California, from lower Owens Valley south to the Little San Bernardino Mountains, east into southern Nye and western Esmeralda Counties, Nevada, and (avoiding the limestones of the eastern Mohave Desert) into southern Clark County, Nevada, and adjoining Mohave County, Arizona.—Map No. 85.—March to May.

ASTRAGALUS LAYNEAE (Mary Katherine Layne, subsequently Mrs. T. S. Brandege, 1844–1920, pioneer California botanist, early curator of the herbarium at CAS) Greene in Bull. Calif. Acad. Sci. 1: 156. 1885.—“Mohave Desert, Parish Brothers, 1882, No. 1273; Mrs. M. K. Layne-Curran, in the same locality, 1884.”—No typus found at CAS or ND, Greene’s original material probably destroyed in the San Francisco fire. Neotypus, *S. B. & W. F. Parish* 1273, collected in May, 1882, on the Mohave Desert, actually at Rabbit Springs, San Bernardino County, US! isotypus, WS!—At UC there is a photograph of Mrs. Curran’s specimen from the Mohave in June, 1884.—*A. malacus* var. *Layneae* (Greene) Jones in Zoë 4: 29. 1893. *Hamosa Layneae* (Greene) Rydb. in Bull. Torr. Club 54: 15. 1927.

To the casual observer the stems of the Layne milk-vetch, as they spring singly or few together at intervals from sands and gravels of the desert floors and foothills, are likely to appear as separate individual plants. Careful digging, however, shows that many of them are connected underground by cords of the diameter of heavy twine, which run horizontally a few centimeters deep for indefinite distances. These cords often creep through a layer of densely compacted hardpan, so are difficult to extract unbroken. Although rootlike in form, they are in reality stem structures, homologous with the caudex-branches of the chamaephytic *Astragalus*, but capable of emitting adventitious rootlets, some of which develop into an independent taproot. The rhizomes are beset with gray-pubescent buds the size of small peas, most of which remain permanently inhibited; here and there one forms the point of origin of an aerial stem. Scarcely one in ten herbarium specimens of *A. Layneae* shows more than the annual herbaceous growth, partly subterranean, with perhaps a fragment of rhizome easily mistaken for a genuine root. Even without its characteristic rhizomes, the Layne milk-vetch is easily recognized by its coarse hirsute vesture, loose, black-hairy racemes of bicolored (purple-tipped) flowers, and long, narrow, bilocular pods. The pods vary greatly in curvature, from crescentic to annular. The less strongly incurved pod is compressed-triquetrous and narrowly grooved dorsally downward from the flattened beak, but a more pronounced or more abrupt

hamate curvature results in opening of the dorsal groove and a tendency toward dorsiventral flattening.

The orientation of the ripe fruit is remarkably variable in *A. Layneae*. The pod most commonly ascends at a narrow angle or is incurved-ascending from a horizontally spreading base; but often it is decidedly pendulous or even abruptly deflexed. The variation or most of it can be attributed to the force of gravity rather than to any physiological peculiarity of the pedicel. When first fully formed the valves of the exceptionally long, naturally ascending pods are heavy with pulp and the peduncles are commonly bent down by their combined weight, the ripening fruit retaining its original attitude relative to the raceme-axis and appearing erect in pressed specimens. Not infrequently a stout or wiry peduncle withstands the burden of the fruits; these are then brought down individually of their own weight into a deflexed position.

The Layne milk-vetch was first collected on March 3, 1854, along the Mohave River, by Bigelow on Whipple's Expedition (NY).

LIX. Sectio MOLLISSIMI

Acaulescent and caulescent, usually tufted perennials, mostly of rapid growth and short duration, with superficial root-crown; *vesture* basifixed, copious, commonly villous-tomentose, composed of shorter, usually curly, together with longer, spirally twisted villi, commonly turning rusty when dry; *stipules* free; *leaves* imparipinnate, with 11–35 leaflets; *flowers* racemose, spreading-ascending, of moderate or large size, the banner 12–33 mm. long; *pedicels* thickened and persistent in fruit; *calyx-tube* cylindric or deeply campanulate; *petals* pink-purple, yellowish suffused with lilac, more rarely ochroleucous, or (in 1 Mexican species) scarlet, regularly graduated, the banner little recurved, the keel-tip rounded or sharply triangular; *pod* spreading or ascending (commonly humistrate), sessile, readily deciduous, obliquely ovate, lance-elliptic, or linear-oblong in profile, straight or strongly incurved, solid or decidedly inflated but not bladdery, $\pm$ dorsiventrally compressed or subterete, the fleshy valves becoming stiffly papery, leathery, or subligneous, inflexed as a complete septum; *dehiscence* apical, after falling; *ovules* 12–38 (41).

The sect. *Mollissimi* was created by Gray to accommodate *A. mollissimus* and *A. Bigelovii*; and mention was made of the Mexican *A. orthanthus* (= our *A. Helleri*) and *A. Humboldtii* (= our *A. mollissimus* var. *iolanus*) as forming a closely related group. The section (including the Mexican elements) was enriched over the years by an accumulation of either closely allied or widely misplaced forms; the core of it, as treated by Jones (1923, p. 230) and by Rydberg (1929, p. 442; 1930, p. 539) has remained essentially the same, and Gray's circumscription still serves its purpose. Species wrongly referred here by Jones, Rydberg, or both, are the chimerical *A. phoenicis*, described from a mixture of *Astragalus* flowers and *Oxytropis* fruits, and *A. (Argophylli) anisus*, distinguished by its dolabriform vesture. The nodding flowers and emmenoloboid fruits of the erect and strongly caulescent *A. giganteus* seem different enough to justify its removal to a separate section, despite the similarity in the stipules, pubescence, and form of the thick-textured, fully bilocular pod; while *A. sanguineus*, despite its resemblance to *A. Helleri* in its long, scarlet flower, has the very thick-walled, ultimately pithy fruits and strigulose vesture of sect. *Sarcocarpi*. The near affinities of sect. *Mollissimi* can be traced in two directions: through *A. Helleri* and *A. sanguineus* to the *Sarcocarpi*; and through a general resemblance in many details to the *Argophylli*, from which, as now reconstituted to embrace some bilocular-fruited species, they can be excluded only on the somewhat flimsy (though easily observed) character of the peculiar vesture.

Each of the three sections mentioned above, the *Sarcocarpi*, *Mollissimi*, and *Argophylli*, has given rise to one species peculiar for its greatly elongated, narrow, and little-curved flower with scarlet petals. Like the two others, the scarlet-flowered *A. Helleri* is placed apart from its drabber relatives in a separate subsection.

Key to the Subsections of Sect. *Mollissimi*

1. Flowers of moderate size, varying from purple to ochroleucous but never red, the banner recurved through $\pm 30^\circ$, the wings and keel obtuse; banner 12–24.5 mm. long; widespread in w. United States and Mexico LIX (i). Subsect. *Mollissimi*
1. Flowers very long (but narrow), scarlet (drying crimson), the banner nearly erect,

the wings and keel both sharply acute; *banner* 25–33 mm. long; Orizaba massif, Puebla and Vera Cruz LIX (ii). Subsect. *Orthanthi*

LIX (i). Subsectio MOLLISSIMI

Flowers varying from purple to ochroleucous, never red, of moderate size, the banner less than 25 mm. long; *keel-tip* obtusely rounded.—Sp. 1, xerophyte, consisting of 10 varieties, widespread over the Great Plains from Nebraska to Texas, west to the Colorado Plateau in Utah and the edge of the Great Basin in southern Nevada, south from northwestern Arizona and Edwards Plateau in Texas through the highlands of Mexico to Puebla.

ASTRAGALUS sect. MOLLISSIMI Gray in Proc. Amer. Acad. 6: 195. 1864.—Sp. typica: *A. mollissimus* Torr.—*A. sect. Mollissimus* Sheld. in Minn. Bot. Stud. 1: 166. 1894, an illegitimate substitute.

The unprecedentedly inclusive concept of *A. mollissimus*, expressed in the following pages, is likely to come as a disagreeable surprise to those familiar with such long-standing and almost universally accepted species as *A. Bigelovii*, *A. Thompsonae*, and *A. Humboldtii*. These names were proposed in the first place for isolated specimens collected at mutually remote points, and no one could have foreseen that they were random samples from a very large and taxonomically difficult complex. With the accumulation of material it has become clear that the idealized characters of the supposed species are subject to great variation, and that at the edge of its range each of the *Mollissimi* passes insensibly into one or two other members of its group. The neat taxonomic facade erected by Rydberg is revealed as no more than that, as soon as a serious attempt is made to apply his specific key to any considerable suite of specimens.

The pod of typical *A. mollissimus* is almost consistently described as glabrous. Jones, to be sure, thought it "inclined to be velvety-pubescent when young but smooth in age." While this statement probably referred to a mixture of genuine var. *mollissimus* and var. *Earlei*, there is a grain of truth in it, for the ovary and forming legume are as often puberulent as truly hairless. The entire surface of the valves is only rarely pubescent, but the beak is often thinly and persistently so, the vesture usually composed of two sorts of hairs, one shorter and curly and the other longer and nearly straight, suggesting a rudiment of the villous-tomentose vesture of *A. Bigelovii*. In fact, the last-named and typical *A. mollissimus* are so closely similar in facies and in fine detail that I feel justified in interpreting them as vicariant races of one species, differing principally in density (but not in kind) of pubescence. In addition, the average pod of *A. Bigelovii* is shorter and the average calyx-teeth shorter relative to the tube, which tends moreover to be more abruptly truncate at base; these are, however, fluctuating and obviously superficial differences. More importantly, perhaps, the beak of the pod is less strongly developed in *A. Bigelovii* than in *A. mollissimus* and the septum, apparently as a consequence, is produced into the apex of the fruit. But the value of this character is depreciated as soon as such closely related pairs of forms as *A. Matthewsii* and *A. Thompsonae*, or *A. Earlei* and *A. Bigelovii*, are examined, one member of each pair differing from the other in the same feature. Other differential characters emphasized in the past have been the inflation and curvature of the pod and the length of the hairs on pods and leaves; these have either proved inconstant or have come to seem of too little importance for specific criteria. The narrowness of the morphological gaps between the various named forms of *A. mollissimus* is described in greater detail below.

233. ASTRAGALUS MOLLISSIMUS

Low, often relatively robust and leafy, densely or quite loosely tufted, perennial but of only a few years' duration, the taproot early becoming woody and the root-crown, in old plants, sometimes developing into a shortly forking caudex, the stems and foliage villous-tomentose (pilose) throughout, the leaves canescent, silvery, or rarely greenish, the vesture usually composed of two sorts of extremely fine hairs, one shorter, curly, entangled, the other longer, spreading-ascending, or rarely retrorse or forwardly appressed, straight or sinuous, spirally twisted, both (in most forms) turning rufous or tawny when dry; *stems* few or many, simple or nearly so, the outer ones prostrate and the inner ascending, often reduced to thick crowns invested with a thatch of imbricated stipules, when caulescent composed of several short internodes and sometimes up to 2 dm. long, but even then forming less than half the total height of the plant; *stipules* 3–17 mm. long, with broad,

semialexicaul bases and blades varying from lanceolate to deltoid-acuminate, or drawn out into caudate-acuminate tips; *leaves* (3) 6–26 cm. long, all petioled (the petioles often thick, stiff, and subsistent), with 11–35 suborbicular, ovate, obovate, or rhombic-elliptic, often thick-textured leaflets 3–45 mm. long, commonly diminishing upward along the rachis; *peduncles* (1.5) 3–25 cm. long, ascending at anthesis, nearly always prostrate or reclinate in fruit; *racemes* (5) 7–45-flowered, at first nearly always dense and short, the axis more or less elongating, (0.5) 1–17 cm. long in fruit; *bracts* membranous or early becoming so, lanceolate or lance-acuminate, 2.5–10 (12) mm. long; *pedicels* straight, ascending, at anthesis 0.5–1.5 mm. long, in fruit thickened and 1–3 mm. long, persistent; *bracteoles* commonly 0, in some vars. 0–2; *calyx* (7) 8–14 mm. long, pubescent like the herbage, the hairs white or exceptionally fuscous or black, the oblique, fleshy disc 1.1–2.3 mm. deep, the cylindric or deeply campanulate, submembranous, often purplish tube usually a trifle constricted upward and thus broadest below the middle, the dorsal side straight, the ventral side somewhat convex or even gibbous behind the pedicel, the lanceolate, subulate, or sometimes subulate-setaceous teeth (1.7) 2–5.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pink-purple, dull pinkish-lavender, yellowish suffused with sordid lilac, or creamy-white drying stramineous, often tending to persist about the forming pod; *banner* gently recurved through about 30°, variable in outline but commonly broadly oblanceolate or spatulate, 12–24.5 mm. long, the long-cuneate claw expanded into an oval, ovate, rhombic-ovate, or rarely suborbicular, shallowly notched or subentire blade $\frac{1}{3}$ – $\frac{1}{2}$ as wide; *wings* as long or somewhat shorter, the blades narrowly oblong or lance-oblong, usually broadest just above the claw and thence often slightly incurved, obtuse or truncate at apex; *keel* shorter than the wings, the lunate or lunately half-obovate blades incurved through 80–100° to the rounded apex; *anthers* 0.5–0.9 mm. long; *pod* spreading or ascending, commonly humistrate, obliquely ovate, lance-elliptic, lunate, or linear-oblong in outline, 9–25 mm. long, 4–13 mm. in diameter, solid or $\pm$ turgid, sometimes decidedly inflated but never bladdery, rounded or (when broad) subtruncate or a trifle umbilicate at base, contracted distally into a short, conical or laterally flattened, deltoid beak, terete when narrow, obcompressed and shallowly sulcate along both sutures when broad, nearly straight to incurved through 90° or slightly more, the fleshy valves becoming stiffly papery, leathery, or subligneous, rugulose-reticulate, glabrous, strigose, or villous-tomentose, inflexed as a complete septum extending up to the base or into the apex of the beak; *seeds* almost round, olivaceous, purplish- or orange-brown, sometimes nearly black or purple-speckled, sparsely punctate to rugulose, dull. 2–2.8 mm. long.

Key to the Varieties of *A. mollissimus*

1. Pod glabrous, thinly puberulent when young, or if permanently pubescent throughout then the hairs less than 1 mm. long (2)
2. Petals purple or suffused with purple, white only in rare albino forms; not of Edwards Plateau, Texas (3)
3. Calyx-tube relatively broad, 3–5 mm. in diameter; range either over the plains from Nebraska to New Mexico and w. Texas, or in Mexico from s. Coahuila s.-ward, but not between (4)
4. Pod glabrous or puberulent in the beak only; Nebraska to s.-e. New Mexico and w. Texas 233a. var. *mollissimus*
4. Pod strigulose or hirsutulous over the whole surface; Coahuila to Puebla (5)
5. Pubescence of the leaves appressed, the foliage silvery-satiny; *pod* strigulose; s. Coahuila 233d. var. *nitens*
5. Pubescence of the leaves hirsute-tomentose; *pod* hirsutulous; Coahuila s.-ward 233e. var. *iolanus*
3. Calyx-tube narrower, 0.8–3 (3.2) mm. in diameter; trans-Pecos Texas to

Chihuahua and Coahuila, passing n.- and s.-ward into the 3 preceding _____

- 233c. var. *Earlei*
 2. Petals cream-colored, immaculate; *pod* glabrous or sparsely pubescent distally; Edwards Plateau, Texas _____ 233b. var. *Coryi*
 1. *Pod* densely pubescent, strigose or villous-tomentose, the longest hairs over 1 mm. long (6)
 6. Racemes (10) 12-many-flowered; if of n.-w. New Mexico either the *pod* less than 7 mm. in diameter and the longest hairs of the calyx and herbage up to 2-3.5 mm. long, or the *pod* strongly beaked and the beak unilocular (7)
 7. *Pod* mostly turgid, ovoid, the beak in any case unilocular; either Colorado Basin to e. Nevada, or centr. to s. Mexico (8)
 8. Acaulescent or nearly so, the stems 0-3 cm. long; *calyx-tube* $\pm$ 8-11 mm. long; *vesture* of the herbage remaining silvery when dry; Colorado Basin to e. Nevada _____ 233j. var. *Thompsonae*
 8. Caulescent, the stems 5-30 cm. long; *calyx-tube* mostly 6-7.5 mm. long; *vesture* of the herbage tarnishing when dry; Coahuila to Puebla, Mexico _____ 233e. var. *iolanus*
 7. *Pod* solid or nearly so, narrowly oblong- or lance-ellipsoid, 3-8 mm. in diameter, the beak fully bilocular (9)
 9. Flowers relatively large, the calyx 10 mm. long or more, the keel 12.3-18.6 mm. long; *pod* 9-15 mm. long; *ovules* 19-30; if of extreme w. Texas then robust and shortly caulescent (10)
 10. Plants usually robust and shortly caulescent, the stems mostly 3-17 cm. long, rarely 0; *leaves* 9-26 cm. long, the leaflets mostly large, 6-25 mm. long; *flowers* relatively large, the keel $\pm$ 13.5-18.5 mm. long; *longest hairs* of the *pod* 1-1.6 mm. long; s.-e. Arizona to extreme w. Texas, rarely over 6000 ft. _____ 233f. var. *Bigelovii*
 10. Plants dwarf, acaulescent; *leaves* (4) 6-16 cm. long, the leaflets smaller, 3-13 mm. long; *flowers* smaller, the keel about 12.5-14.5 mm. long; *longest hairs* of the *pod* 1.6-2.6 mm. long; plateaus of n. Arizona and w.-centr. New Mexico, on and near the Mogollon Escarpment or n. of it, 6200-7500 ft. _____ 233h. var. *mogollonicus*
 9. Flowers smaller, the calyx 7-9.5 mm., the banner 12.4-16.3 mm., the keel 10.3-12.5 mm. long; *pod* 6-10 mm. long; *ovules* 12-16; dwarf acaulescent plants of trans-Pecos Texas (Presidio and Jeff Davis Counties) _____ 233g. var. *marcidus*
 6. Racemes (5) 7-12-flowered; *pod* broadly ovoid, 12-18 mm. long, 7-13 mm. in diameter, shortly conic-beaked; *longest hairs* of calyx and herbage 1-2 mm. long; n.-w. New Mexico (Santa Fe to McKinley County) _____ 233i. var. *Matthewsii*

233a. ASTRAGALUS MOLLISSIMUS var. MOLLISSIMUS

Relatively stout and robust, subacaulescent or commonly short-caulescent, the stems 1.5-14 cm. long, the internodes all concealed by imbricated stipules or 1-few developed and up to 4 cm. long, the herbage densely silky-tomentose, the longest, narrowly ascending or spreading hairs up to 1-2.5 mm. long, the *vesture* ultimately becoming rusty; *stipules* large and conspicuous, (5) 7-17 mm. long; *leaves* (7) 10-20 (25) cm. long, with 15-27 (33) oval, ovate, or obovate and obtuse, sometimes rhombic-elliptic and subacute leaflets 5-22 mm. long; *peduncles* 6-21 cm. long; *racemes* oblong and rather dense at early anthesis, (10) 15-40-flowered, the axis elongating, (2) 4-17 cm. long in fruit; *calyx* (8.8) 10.5-14 mm. long, the tube 6.8-9.5 mm. long, 3.4-4.5 mm. in diameter, the teeth (2) 3-5 mm. long; *petals* yellowish suffused with dull lavender, or pinkish, or pink-purple (exceptionally "yellow" in fma. *flavus*); *banner* (16) 17.5-21.5 mm. long, 7.2-10.5 mm. wide; *wings* 15.5-21 mm. long, the claws 7.3-10.8 mm., the blades 9.4-11.7 mm. long, 2.3-3 mm. wide; *keel* (14) 14.5-18 mm. long, the claws (7.5) 8.5-11 mm., the blades 7.4-9 mm. long, 2.9-3.4 mm. wide; *pod* narrowly oblong-ellipsoid to lance-ellipsoid, 1.4-2.4 cm. long, 4-7 mm. in diameter, shallowly crescentic or abruptly incurved near the middle through $\pm$ 90°, contracted distally into a short but evident, conical or deltoid-acuminate, compressed, unilocular beak, the valves commonly glabrous, almost as often glabrous except for

the puberulent or hispidulous apex, rarely puberulent or even shortly villosulous throughout; *ovules* 26–37.—Collections: 86 (xii); representative: *Rydberg* 67 (NY); *A. Nelson* 3627 (NY); *W. A. Weber* 3293 (CAS, RSA, TEX, WS); *Ripley & Barneby* 8285 (CAS, RSA), 11,157 (CAS, NY, RSA); *Eggleston* 20,000, 20,056 (NY); *Waterfall* 7889 (OKLA, TEX), 9433 (OKLA, SMU), 10,616 (OKLA, RSA); *Demaree* 7606 (MO, WIS); *Shinners* 8329 (SMU).

Prairies, plains, valley floors, stony mesas and fallow fields in alluvial loams, loess, or on outcrops of shale, limestone or sandstone, most abundant where vegetation (due either to site or overgrazing) is low and sparse, widespread and locally abundant between 1700 and 6000 feet over the western Prairie States, ascending in New Mexico into dry pine woods up to 7000 feet, western and south-central Nebraska and southeastern Wyoming to western Oklahoma, northwestern Texas, and the Pecos and Rio Grande Valleys in central and southeastern New Mexico.—Map No. 97.—Late April to July, sometimes again in fall.

ASTRAGALUS MOLLISSIMUS (very soft, of the vesture) Torr. in Ann. Lyc. N. Y. 2: 178. 1827.—“On the Platte.”—Holotypus, collected by Dr. Edwin James, assistant surgeon U. S. A., on Long’s Expedition in 1820, NY! isotypus (a pod), GH!

Phaca villosa (villous) James ex Wats., Bibl. Ind. 197. 1878, in syn., nom. nud.

Astragalus simulans (simulating *A. mollissimus*) Ckll. in Torreyia 2: 154. 1902.—“Stony hills at Las Vegas, New Mexico . . . May 18, 1901, T. D. A. & W. P. Cockerell . . . type . . . in N. Y. Botanical Garden.”—Holotypus, NY! isotypus, GH!

Astragalus mollissimus fma. *flavus* R. L. McGregor in Rhodora 62: 116. 1960.—“T32S, R14W, Sec. 20, Gypsum Hills prairie, Barber County, Kansas, April 25, 1959, McGregor 14186 (Type KANU).”—No typus examined.

The woolly locoweed, var. *mollissimus*, a common and justly feared stock-poison of the Prairie States lying between western Nebraska and the Texas Panhandle, is a rather handsome plant. Although all specimens are technically caulescent, the stems are short and densely leafy, so that the silvery-gray foliage is tufted into low, mounded clumps. The peduncles, commonly appearing scapose or nearly so, are incurved-ascending when the flowers are in bloom, but become prostrate and radiate from the root-crown as the fruit is ripening. Within its species the distinctive features of var. *mollissimus* are the relatively broad calyx and narrow pod, which varies, however, considerably in length and curvature. The ripe fruit disjoints readily from the receptacle, and at dehiscence the gaping unilocular beak provides ready egress to the seeds. The flowers vary from a deep and lively wine-purple through shades of pinkish-lavender to tawny-yellow suffused with lurid purple; a population of plants with truly yellow petals has been described from Barber County, Kansas (fma. *flavus* McGregor). The latter would key out to var. *Coryi* but is, in all probability, an independent mutation which has not achieved an independent geographic range. The pod, as I have already mentioned, varies from glabrous to strigulose, when the hairs may cover the whole surface or, more commonly, are concentrated toward the beak. In general a pubescent pod becomes more frequent southward as the range of the vicariant var. *Earlei* is approached. In southeastern New Mexico and adjoining Texas the vars. *mollissimus* and *Earlei* are morphologically confluent, a situation discussed further under the latter heading. In the higher foothills on and about the Pecos-Rio Grande divide in New Mexico, the flowers of the woolly locoweed are a trifle smaller than in the phase prevailing over the open prairies; but this small-flowered form, described as var. *simulans*, departs too little from the standard var. *mollissimus* to deserve taxonomic recognition.

The var. *mollissimus*, which became by the fortunes of history the prototype of its widely dispersed species, is probably a derived form. The approximate geographic center of the woolly locoweed, which coincides with the area of maximum variation, lies in the upper Rio Grande Valley, and it can be assumed that var. *mollissimus* is a modified offshoot of an ancestor with pubescent pod.

The toxic principle of *A. mollissimus* was isolated from var. *Earlei* by Fraps & Carlyle (1936), who labeled it locoine and believed it to be an alkaloid or closely related substance. The varieties of *A. mollissimus* are probably all toxic, especially to horses, and in slightly less degree to cattle, sheep, and goats. We have no experimental data concerning var. *Thompsonae*, or the Mexican var. *iolanus*, or the rare vars. *mogollonicus*, *marcidus*, and *Matthewsii*. An informative summary of what was known about loco disease to date may be found in U. S. Department of Agriculture Farmers’ Bulletin No. 1054 (Marsh & al., 1919, revised in 1936 by A. B. Clawson).

233b. *ASTRAGALUS MOLLISSIMUS* var. *CORYI*

Habit and vesture of var. *mollissimus*, the stems 2–25 cm. long, the longer, spirally twisted hairs up to 1.6–2.8 mm. long; *stipules* triangular-acuminate or lance-caudate, (5) 7–15 mm. long; *leaves* (4) 6–20 cm. long, with (11) 17–25 (29) obovate or oblong-oval and obtuse, or rhombic-obovate and subacute leaflets 5–18 mm. long; *peduncles* 8–21 cm. long; *racemes* densely 15–45-flowered, the axis 3.5–9 cm. long in fruit; *calyx* 10.5–14 mm. long, the cylindric or subcylindric tube 7–8.7 long, 3–4 mm. in diameter, the teeth (3.3) 3.7–5.5 mm. long; *petals* cream-colored, immaculate; *banner* (14.4) 15–20.3 mm. long, (5.9) 6.5–9.6 mm. wide; *wings* (13) 13.7–19.7 mm. long, the claws (6.8) 7.5–10.5 mm., the blades 7.3–10.7 mm. long, 1.7–2.8 mm. wide; *keel* 12–17.4 mm. long, the claws (6.6) 6.9–10.2 mm., the blades 6–7.9 mm. long, 2.6–3.3 mm. wide; *pod* narrowly ovoid or oblong-ellipsoid, 1–1.7 cm. long, 4.5–7 mm. in diameter, glabrous or thinly hispidulous distally, the beak unilocular.—Collections: 19 (o); representative: *Cory* 50 (GH), 56 (NY), 59 (NY), 114 (MO), 12,457 (TEX), 39,172 (TEX, topotypus), 41,447 (NY), 53,399 (SMU, SRSC, WS); *Parks & Cory* 28,755 (SMU), 28,760 (TEX); *J. Reverchon* 1281 (NY, MO).

Calcareous clay flats and depressions on rolling plains, locally plentiful in a small area of the Edwards Plateau, between the lower Pecos and upper Concho Rivers, in Sterling, Reagan, Upton, and Crockett Counties, Texas.—Map No. 97.—March to May, sometimes again after summer or fall rains.

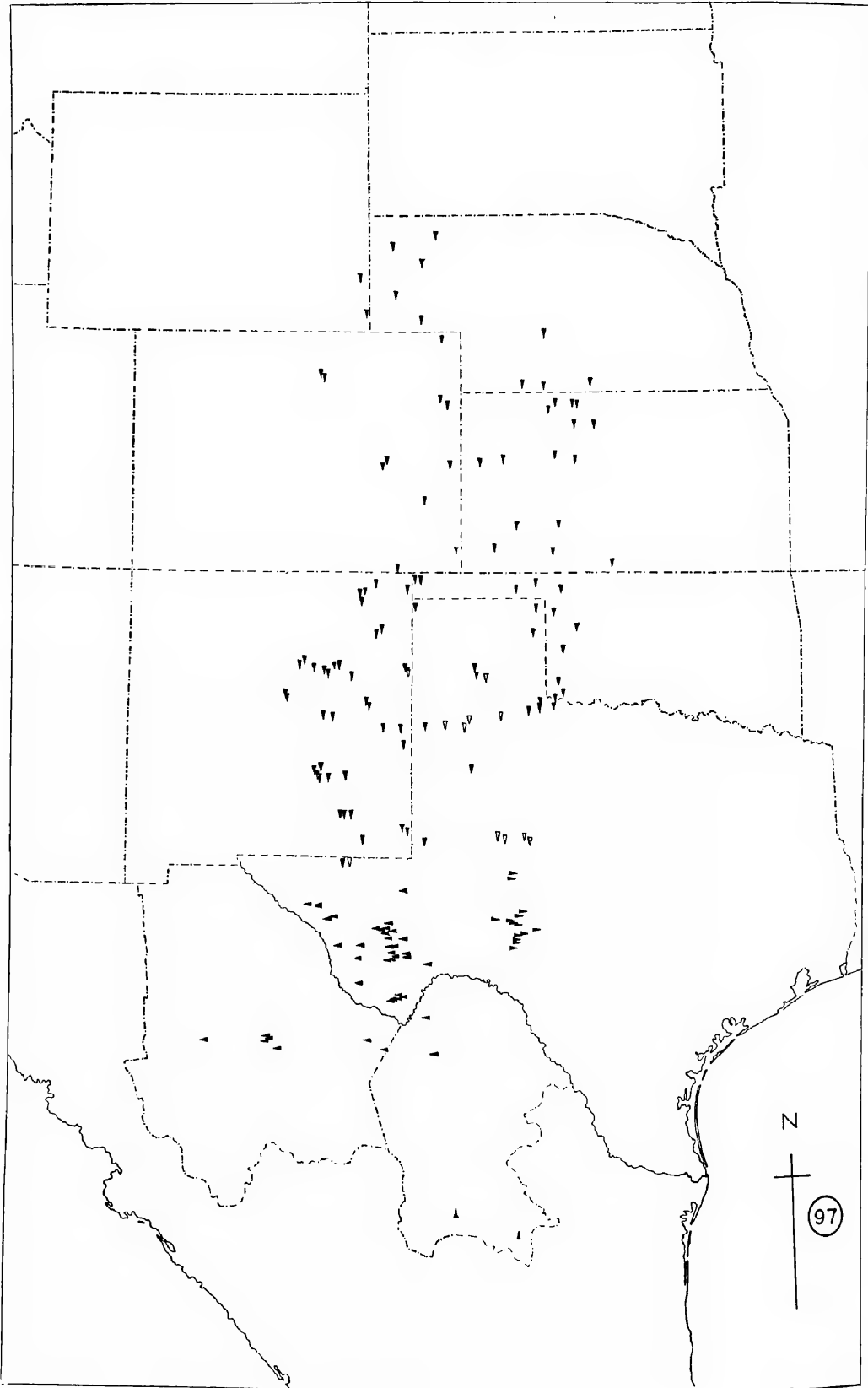
ASTRAGALUS MOLLISSIMUS var. *CORYI* (Victor Louis Cory, 1880—) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937, based on *A. argillophilus* (delighting in clay soils) Cory in Rhodora 32: 5. 1930.—“The TYPE specimen, No. 134, was collected May 5, 1929, from a northern tributary of Bates Draw at a point six miles north of Big Lake in Reagan County, Texas.”—Holotypus, not examined, TAES; a topotypus, and many collections distributed by Cory himself, are decisive.

Cory's woolly locoweed is excessively close to var. *mollissimus*, apparently differing only in the petal-color, although this is constant, and correlated with a disjunct dispersal. The flowers of var. *Coryi* are on the average a trifle smaller, and the pods somewhat more plumply ovoid in outline than those of var. *mollissimus*, but there is a wide overlap in all measurements.

The first collection of var. *Coryi* (*Reverchon* 1281 from the upper Concho River) was referred by Rydberg (1930, p. 540) to *A. giganteus*; and Jones (1930, p. 27) made the same error when he encountered it near Ozona (*Jones* 26075, CAS, MO). Resembling var. *Coryi* superficially in its ochroleucous flowers and glabrous fruit, *A. giganteus* is easily distinguished by its few, stiffly erect stems, retrorsely imbricated, nodding flowers, and fruit securely attached to the receptacle until long after dehiscence. Moreover, it is a plant of streamsides in xeric pine forest, flowering in summer rather than in spring, and is known in Texas only from the Davis Mountains.

233c. *ASTRAGALUS MOLLISSIMUS* var. *EARLEI*

Densely or loosely tufted, subcaulescent or shortly caulescent, the stems up to 1 (1.6) dm. long but mostly shorter, the herbage densely silky-pilose throughout, the longest, spreading or narrowly ascending, spirally twisted hairs up to 1.5–2.5 mm. long, the vesture becoming rufous in age; *stipules* mostly large and conspicuous, 5–15 mm. long; *leaves* 8–32 cm. long, with 19–35 oblanceolate, rhombic-ovate, or -obovate, obtuse or subacute leaflets (5) 10–30 (45) mm. long; *peduncles* (5) 8–17 cm. long; *racemes* oblong at anthesis, 15–36-flowered, the axis elongating, 4–15 cm. long in fruit; *calyx* (8.5) 8.8–10.5 mm. long, the tube (4.5) 5–7 mm. long, 0.8–3 (3.2) mm. in diameter, the teeth 2.4–4 mm. long; *petals* pink-purple or yellowish tipped and suffused or margined with dull purple, the wing-tips usually pale, whitish or yellowish; *banner* 12–17.5 mm. long, 4.5–7.5 mm. wide; *wings* 12–14.8 (15.7) mm. long, the claws 5.5–7.2 mm., the blades 7–8.6 (9.8) mm. long, 1.5–2.2 (2.5) mm. wide; *keel* 9–13 mm. long, the claws



5.5–7.6 mm., the blades 5.3–6.2 mm. long, 2–3 mm. wide; *pod* obliquely ovate- or lance-ellipsoid, 9–14 mm. long, 4–6.5 (9) mm. in diameter, more or less incurved, abruptly contracted distally into a short, unilocular beak, the valves thinly villous-tomentulose or loosely strigulose with almost straight, ascending, or curly and subappressed hairs less than 1 mm. long, occasionally nearly, rarely quite glabrous; *ovules* 20–30.—Collections: 90 (v); representative: *Warnock* 520 (MO, SMU, TEX); *Mueller* 8048 (NY, MO, TEX); *Jones* 26,433 (POM, US), 28,197 (CAS, POM); *Eggleston* 21,902 (MO, NY); *Ripley & Barneby* 11,129 (CAS, NY, RSA); *Mexia* 2552 (US), 2553 (CAS, NY); *Johnston* 8537 (GH); *Stanford, Weatherford & Northcraft* 253 (GH, NY).

Dry hills and grassy plains, equally vigorous on volcanic and calcareous soils, about 3750–5800 feet, widespread and common from the foothills of the Davis Mountains and the Big Bend country of trans-Pecos Texas south to southern Coahuila and west to the foothills of the Sierra Madre Oriental in central Chihuahua; intergradient populations combining either the larger flower of var. *mollissimus* with relatively broad, pubescent pod, or narrower flower of var. *Earlei* with glabrous pod represent the species northward into the Texas Panhandle and southeastern New Mexico.—Map No. 97.—March to June, exceptionally and sporadically in fall.

ASTRAGALUS MOLLISSIMUS var. *EARLEI* (Greene ex Rydb.) Tidest. in Proc. Biol. Soc. Wash. 48: 40. 1935; and in op. cit. 50: 21. 1937, based on *A. Earlei* (Franklin Sumner Earle, 1856–1929, mycologist and plant collector) Greene ex Rydb. in N. Amer. Fl. 24: 444. 1929.—“Type collected in Limpia Canyon, Texas, April 5—May 3, 1902, *Earle & Tracy* 226 . . .”—Holotypus, collected April 25, 1902, NY! isotypi, G, GH, MO, ND, TEX, US!—Note that *Earle & Tracy* 331, collected April 2, 1902, labeled “*A. Tracyi* Greene, type-collection,” ND, NY, MO, TEX, are conspecific but not type-material. Limpia Canyon is in the Davis Mountains, Jeff Davis County.

Astragalus pervelutinus (very velvety) Rydb. in N. Amer. Fl. 24: 444. 1929.—“Type collected near the City of Chihuahua, April 1, 1885, *Pringle* 189 . . .”—Holotypus, NY! isotypi PH, US!

Earle's woolly locoweed is very closely related to var. *mollissimus*, differing ideally, and over a great part of its range consistently, in the narrower calyx, ordinarily shorter flower, and (with reservations) pubescent pod. However, on the Staked Plains of northern Texas, the common representatives of *A. mollissimus* combine the small, narrow calyx of var. *Earlei* with a pod glabrous or nearly so as in var. *mollissimus*, while the latter, as defined by its large flower, shows an increasing tendency for a pubescent pod as it comes southward through eastern New Mexico to the Texas line. In the Chisos Mountains of the Big Bend, the pod of otherwise characteristic var. *Earlei* varies from densely pubescent throughout to glabrous except for a few hairs about the beak; and there are a few records from this area of a truly glabrous ovary and pod (cf. *Moore & Steyermark* 3227, MO). The varieties thus intergrade in all differential characters. For the purposes of identification of the intermediate forms, I have chosen arbitrarily to regard the proportions of the flower, more constant in a given colony than the vesture of the fruit, as the deciding factor.

The typus of *A. pervelutinus* does not seem to differ substantially from other collections from near Chihuahua City, several of which, including an isotypus (US), were identified as *A. Earlei* by Rydberg. The vesture of these Mexican plants is perhaps (especially when young) a trifle more silken than is usual in the Texan material of Earle's woolly locoweed, but the flowers and pods are identical. In southern Coahuila and San Luis Potosí some populations combine with the narrow calyx, or with the narrow firm pod of var. *Earlei*, the ordinarily ampler flower of var. *irolanus*, and here again one has difficulty in separating the varieties.

233d. *ASTRAGALUS MOLLISSIMUS* var. *NITENS*

Habit of var. *Earlei*, shortly caulescent, the stems up to 1 dm. long, the herbage satiny-canescient with appressed and a few longer, very narrowly ascending

Map No. 97. Parts of western United States and northern Mexico. Range (in part) of *A. mollissimus*: ◀ var. *mollissimus* (↔ intergrades to var. *Earlei*); ♦ var. *Earlei*; ♠ var. *Coryi*; and ▲ var. *nitens*.

hairs up to 0.8–1.2 mm. long, the vesture tarnishing in age; *stipules* up to 1 cm. long; *leaves* 5–16 cm. long, with 21–31 oblong-oblancoolate or elliptic, obtuse or subacute leaflets 7–20 mm. long; *peduncles* (3) 5–10 cm. long; *racemes* 15–30-flowered, the axis 5–10 cm. long in fruit; *calyx* 9.3–11.6 mm. long, densely white-silky, the tube 5.8–6.4 mm. long, 3–3.5 mm. in diameter, the teeth 3.1–5.3 mm. long; *petals* apparently purplish; *banner* 15.3–16 mm. long, 5–6 mm. wide; *wings* 14.2–15 mm. long, the claws 6.8–7.4 mm., the blades 8.5–9.2 mm. long, 1.8–2 mm. wide; *keel* 12–12.7 mm. long, the claws 6.8–7.3 mm., the blades 5.8–6.2 mm. long, 2.5–2.8 mm. wide; *pod* narrowly and obliquely ovoid, $\pm$ 1.1–1.4 cm. long, 3.5–4.5 mm. in diameter, a little incurved, contracted at apex into a short, unilocular beak, the valves strigulose with appressed hairs up to 0.4–0.6 mm. long; *ovules* $\pm$ 30.—Collections: 2 (o); representative: *Palmer* 241 (US).

Habitat not recorded, but to be sought on dry grassy or brushy hillsides, known only from southern Coahuila (Parras; Saltillo).—Map No. 97.—May and June.

ASTRAGALUS MOLLISSIMUS var. *NITENS* (shining), var. nov., var. *iolano* arcte affinis, foliis pube appressa argentea sericeo-canis nec hirsuto-tomentulosis, legumine striguloso nec hirsutulo absimilis.—COAHUILA: Parras, June 8–28, 1880, *Edward Palmer* 242.—Holotypus, US!

These two gatherings of Palmer's pioneer collection in southern Coahuila were referred by Watson (in Proc. Amer. Acad. 17: 342) to *A. Humboldtii* (= our var. *iolanus* below) from which they differ in the lustrous, almost silver-plated vesture of the leaves and the strigulose rather than hirsutulous or hirsute pod. The individual flower is that of var. *iolanus*, but the small, strigulose pod resembles that of var. *Earlei*, and var. *nitens* possibly represents no more than one of several minor variants transitional between its northern and southern relatives. Its status will remain uncertain until we can learn more of its habits and habitat.

233e. *ASTRAGALUS MOLLISSIMUS* var. *IOLANUS*

Loosely tufted, the stems 5–29 (30) cm. long, exceptionally subacaulescent, the herbage densely hirsute-tomentose with shorter, curly together with longer, spirally twisted hairs up to (0.7) 1–2 mm. long, the vesture becoming tawny in age; *stipules* 2–16 mm. long, deltoid or lance-acuminate; *leaves* (6) 10–20 (26) cm. long, with (13) 23–33 obovate to elliptic, obtuse or more rarely acute leaflets 6–25 mm. long; *peduncles* 6–18 (20) cm. long; *racemes* 10–25-flowered, the axis (1.5) 3–7 cm. long in fruit; *calyx* 9–13 mm. long, densely villous or villosulous like the herbage, the tube (5) 5.8–7.5 (8) mm. long, (2.5) 3–5 mm. in diameter, the teeth 3–6 (9) mm. long; *petals* ochroleucous with pale wing-tips and purple-tipped keel, or $\pm$ suffused with lilac-purple; *banner* (15.3) 16–23.5 mm. long, 7–9 mm. wide, sometimes subacute or mucronate in the apical notch; *wings* (14.5) 15.2–20.2 mm. long, the claws 6–7.6 mm., the blades 8.5–13.2 mm. long, 2–3.5 mm. wide; *keel* 11–13.6 mm. long, the claws 6–8 mm., the blades 5.5–7.6 (7.9) mm. long, 2.7–3.2 mm. wide; *pod* narrowly to broadly and plumply ovoid, (1) 1.1–2.3 (2.5) cm. long, 4–13 mm. in diameter, straight or somewhat incurved, the beak unilocular, the valves hirsute or hirsutulous with $\pm$ spreading hairs up to 0.5–1.2 mm. long; *ovules* 22–28.—Collections: 30 (o); representative; *Palmer* 14, 49 (NY, US); *Johnston* 7274 (US), 7469 (GH); *Schneider* 1006 (NY, US); *Rose, Painter & Rose* 9173 (US), 9756 (NY, US), 8810 (NY), US; *Matuda* 21,159 (MICH, NY), 18,538, 21,498 (NY); *Pringle* 8565 (DAV, NY, POM, US); *Galeotti* 3438 (G, P).

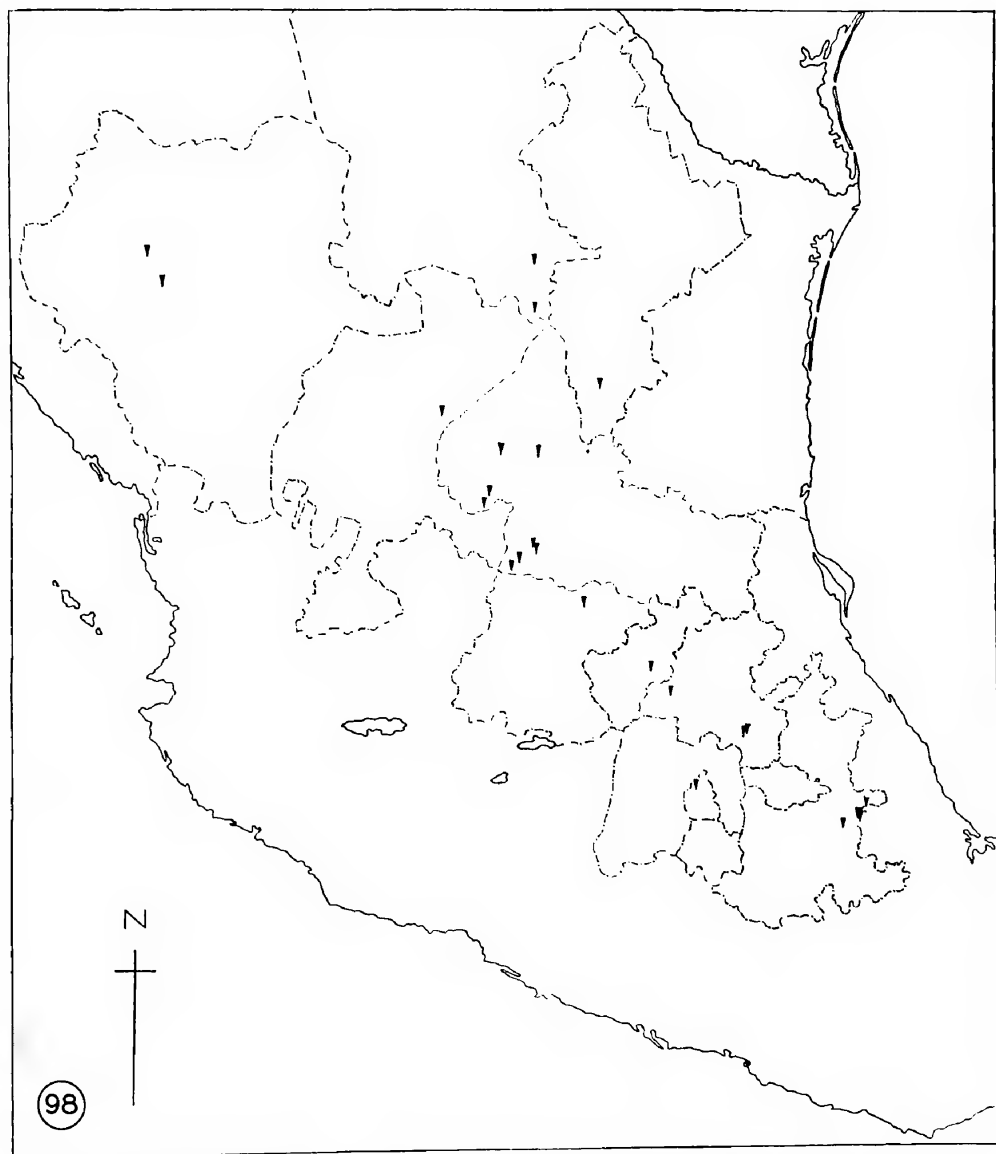
Plains, dry hillsides, fallow fields, roadsides, reaching 13,000 feet on Mt. Orizaba but mostly 5500–9000 feet, apparently common and locally plentiful, central Durango to southern Coahuila and southwestern San Luis Potosí, south to the Valley of Mexico and the Orizaba massif in Puebla (and possibly adjoining Vera Cruz).—Map No. 98.—May to October.

ASTRAGALUS MOLLISSIMUS var. *IROLANUS* (Jones), comb. nov., based on *A. orizabae* var. *irolanus* (of Irola, Hidalgo) Jones, Rev. Astrag. 235, Pl. 60. 1923 ("*Irolanus*").—"Collected near Irola Mexico by J. N. Rose, June 14, 1899, Nat. Herb. No. 346530, the upper plant on the sheet..."—Holotypus, *Rose & Hough 4557*, US! isotypus, NY!—*A. irolanus* (Jones) Rydb. in N. Amer. Fl. 24: 444. 1929.

Phaca mollis (soft, of the vesture) Kunth in H. B. K., Nov. Gen. Sp. 6: 388, Pl. 585. 1823.—"in convalli Mexicana prope Gasave [near Pachuca, fide Sprague in Kew Bull., 1924, p. 22]."—Holotypus, P (herb. Humb.)!—*Astragalus Humboldtii* (Friedrich Heinrich Alexander von Humboldt, 1769–1859) Gray in Proc. Amer. Acad. 6: 195. 1864, a legitimate substitute (non *A. mollis* M. B., 1819).

Astragalus orizabae (of Mt. Orizaba) Seaton in Proc. Amer. Acad. 28: 117. 1893 ("*Orizabae*").—"Ledges and cliffs, Mount Orizaba, 9000 feet, August. (Seaton 262)."—Holotypus, collected August 8, 1891, GH! isotypus, NY!

Astragalus niquiriciaefolius (meaning obscure, unless a misprint for "*liquiritiaefolius*," with leaves of liquorice or *Glycyrrhiza*) Sessé & Mocino, Fl. Mex., Ed. 2. 168. 1894; Ed. 1. 184.



Map No. 98. Central and northeastern Mexico. Range of *A. mollissimus* var. *irolanus*.

1895.—“Habitat in agris arenosis Regionum frigidarum, ubi vulgo Garbancillo indigenae appellant . . .”—Lectotypus, “*Astragalus equicida*,” Sessé & Mocino Herb. No. 3750, MA! isotypus, OXF!

Humboldt's woolly locoweed, var. *irolanus*, is very close to var. *Earlei*. Indeed the two varieties are not reliably distinguished by any one differential character, and in the latitude of southern Coahuila ($\pm 25^\circ$ N.) there exist transitional forms, already mentioned under var. *Earlei*, which are difficult to assign to either. For the most part, and nearly always southward from San Luis Potosí, the calyx of var. *irolanus* is broader than that of var. *Earlei* and has longer teeth; at the same time, the banner tends to be slightly longer and the pod more tumid or distinctly inflated and of plumper outline. Even in southcentral Mexico, however, the pod varies considerably in size and profile and provides no solid criterion. The plant collected at Gasave in southern Hidalgo by Humboldt and Bonpland, the original *Phaca mollis*, was in flower only. Had the bilocular pod been known, the species would have been described as an *Astragalus*, not as a *Phaca*. Perhaps it will never be known how the fruit would have turned out, for narrower and broader types occur together in the Valley of Mexico. When Seaton described *A. orizabae*, he assumed that *Phaca mollis* (*A. Humboldtii*) had a small, narrow pod as in var. *Earlei*. Jones (1923) also associated the name *A. Humboldtii* with narrow-fruited plants, but his concept was an extremely muddled one, based on a mixture of var. *Bigelovii*, var. *Earlei*, and perhaps a small element of our var. *irolanus*. On the other hand, Rydberg (1929) assumed that *A. Humboldtii* would have had the plump tumescent pod of *A. orizabae*, and he treated these two as synonyms, taking up the name *A. irolanus* for the southern plant with narrow pod. However, I feel pretty sure that there is only one woolly locoweed in southcentral Mexico and that the variation in the pod is of a superficial nature. The var. *irolanus* was originally described as differing from *A. orizabae* in a proportionately longer (although still tumid) pod and leaflets of acutely rhombic outline. These features are not correlated in other collections, and there is no reason to interpret the type-collection as a mixture of significantly different forms.

I have listed *A. niquiriciaefolius* as a synonym of var. *irolanus*, even though no Sessé & Mocino specimens so labeled are known to exist. The description of the species fits var. *irolanus* well, and the plants were said to be poisonous to sheep, cattle, and horses. The vernacular name garbancillo, used in Spain for *A. lusitanicus* Lamk. and in Latin America (both North and South) for a variety of toxic astragali, was already current for *A. niquiriciaefolius* in Mexico at the end of the XVIII century. The choice of Sessé & Mocino's “*Astragalus equicida*,” a name obviously applied to a known locoweed, seems appropriate. Other specimens from “Nueva España,” all probably dispersed by Pavón out of the collections of Sessé and his collaborators, are labeled: “*A. contortuplicatus*” (BM, MA), this possibly the basis of *A. contortuplicatus* sensu S. & M., Pl. Nov. Hisp. 119. 1889 (non L.); “ex herb. Pavon.” (G, herb. Moricand.); and “*Crotalaria* sp. nov. de Mexico” (BM).

233f. ASTRACALUS MOLLISSIMUS var. BIGELOVII

Coarse and robust, nearly always shortly caulescent, the stems composed of up to 7 developed internodes and commonly 3–17 cm. long, sometimes essentially acaulescent, the herbage very densely, finely, and loosely villous-tomentose, the longer, spreading or ascending hairs up to (1.2) 1.5–2.7 mm. long, the vesture becoming rufous when dry; *stipules* large and conspicuous, 6–20 mm. long; *leaves* 9–26 cm. long, with (13) 19–27 ovate, obovate, oval, or broadly elliptic, obtuse or subacute leaflets 6–25 mm. long; *peduncles* (5) 8–22 cm. long; *racemes* oblong, rather densely (15) 20–45-flowered, the flowers subcontiguous or interrupted proximally, the axis (4) 5–11 cm. long in fruit; *calyx* 10.5–13.5 cm. long, the tube (8) 8.3–10.3 mm. long, (3.2) 4–5.2 mm. in diameter, the teeth (1.7) 2.6–4.4 mm. long; *petals* pink-purple; banner 17–22.5 mm. long, 9–11.5 mm. wide; *wings* 15–20.7 mm. long, the claws 7.4–10.6 mm., the blades 8.6–11.5 mm. long, 2.3–3.1 mm. wide; *keel* 13.4–18.6 mm. long, the claws 7.2–10.3 mm., the blades 6.6–9.3 mm. long, 2.7–3.8 mm. wide; *pod* ovoid-acuminate or lance-ellipsoid, gently incurved or nearly straight, 1–1.5 cm. long, (4) 4.5–8 mm. in diameter, sometimes a little turgid, the stiffly papery or leathery valves densely villous-tomentulose, the longest hairs up to 1–1.6 mm. long, the beak bilocular; *ovules* 20–31.—Collections: 52 (vi); representative: Jones 26,074 (CAS, POM); Pringle (from Santa Rita Mountains, Arizona) in 1884 (CAS, NY); McVaugh 8066 (SMU, TEX);

Metcalf 943 (CAS, NMC, US); *Ripley & Barneby* 11,166, 11,174 (CAS, RSA); *Warnock* 7680 (SRSC, TEX); *Mex. Bound. Surv. (Parry)* 256 (NY).

Dry plains and foothills, in desert- or mesquite-grassland, sometimes among junipers, apparently most abundant on calcareous (caliche) soils but also in sandy loams of various origins and occasionally on basalt gravel, especially common on over-grazed and badly eroded cattle ranges, 4000–6000 (rarely up to 7500) feet, widespread and locally plentiful from extreme western Texas (Hudspeth County) west through southwestern New Mexico to southeastern Arizona (to Pima and Santa Cruz Counties), ascending the Rio Grande in New Mexico as far as Socorro and the San Augustine Plains in Catron County; to be expected in adjoining Mexico.—Map No. 99.—(January) March to June.

ASTRAGALUS MOLLISSIMUS var. *BIGELOVII* (Gray) Barneby ap. B. L. Turner, Legum. Tex. 191. 1959, based on *A. Bigelovii* (John Milton Bigelow, 1804–1878, botanist with Lieut. Whipple's Expedition of 1853–55) Gray, Pl. Wright. 2: 42. 1853.—“On the Organ Mountains northeast of El Paso; April 30; chiefly in fruit. (1358).”—Holotypus, (*Wright 1358*), collected April 30, 1852, GH! isotypi, K, NY, P, PH, SMU, US!—*Tragacantha Bigelovii* (Gray) O. Kze., Rev. Gen. 943. 1891 (“*Bigelowii*”). *Astragalus Bigelovii* var. *typicus* Barneby in Leaf. West. Bot. 4: 60. 1944.

The varieties of the woolly locoweed described up to this point are closely interrelated and morphologically confluent where their ranges meet, forming a major division of the species. With var. *Bigelovii* we begin to consider a new set of varieties, quite similar to the foregoing in general aspect but differing in the inner structure of the pod, which is divided completely into two closed chambers by a septum produced into the apex of the short beak. In this group, which consists of vars. *Bigelovii*, *marcidus*, *mogollonicus*, and *Matthewsii* (the last transitional to a third group), the fruit dehisces apically as in var. *mollissimus*, but no aperture is provided for immediate dispersal of the seeds. These can only escape after the fallen pod has weathered on the ground or been broken open by animal agency.

Bigelow's woolly locoweed is the commonest member of its group; it is also the most leafy and coarsest in growth. In the yucca-grassland and mesquite-desert of southern New Mexico and adjoining Arizona and Texas, it plays the role of var. *mollissimus* on the prairies, becoming especially abundant on over-grazed and consequently eroded range. Equally poisonous when eaten fresh, as happens mostly in the early, arid spring months before the palatable grasses are vegetatively active, the mowed and dried plants are reportedly taken without ill effect. The leading features of var. *Bigelovii* are the exceptionally long, silvery but ultimately rusty, spirally twisted villi which clothe the stems and leaves, the comparatively large, purple flowers, and the densely villous-tomentulose pods which seem oddly small for the size of the plant. Known to be abundant in several places along the international boundary in New Mexico and Arizona, it must inevitably be collected in the future in northern Chihuahua and the northeast corner of Sonora; it is curious that there is no Mexican record for so conspicuous a plant.

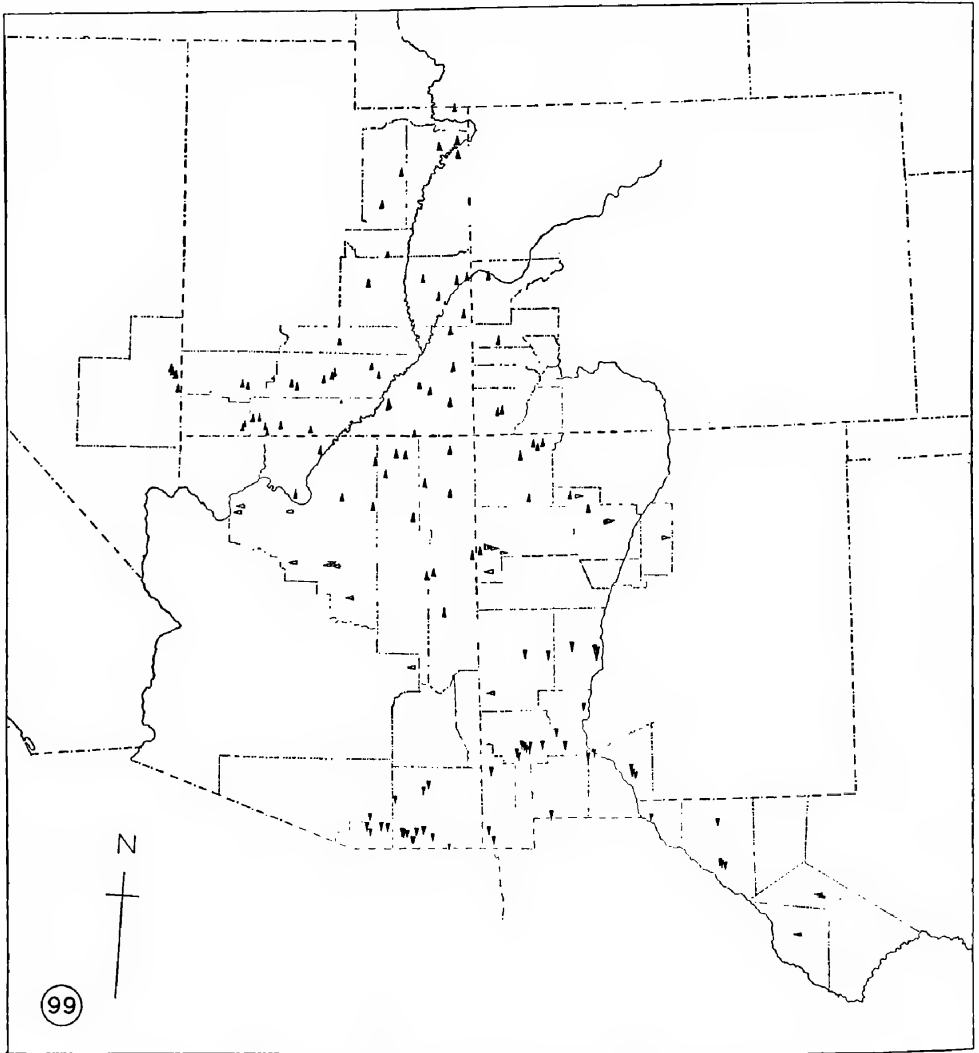
233g. *ASTRAGALUS MOLLISSIMUS* var. *MARCIDUS*

Closely resembling var. *Bigelovii* except for the small flower and pod, acaulescent or nearly so, densely villous, the longest hairs of the herbage up to 1.7–2.5 mm. long; leaves 5–15 cm. long, with 15–19 (21) leaflets 4–15 (20) mm. long; peduncles 3.5–11 cm. long; racemes 10–45-flowered, the axis 3–10 cm. long in fruit; calyx 6.8–9.9 mm. long, the tube 5.2–6.4 mm. long, 2.8–3.5 mm. in diameter, the teeth 1.6–3.5 mm. long; petals pink-purple; banner 11.8–16.3 mm. long, 4.2–8.3 mm. wide; wings 11–14.4 mm. long, the claws 5.2–7 mm., the blades 6.7–8.6 mm. long, 1.8–2.3 mm. wide; keel 9.9–12.5 mm. long, the claws 5.3–7.2 mm., the blades 5–6 mm. long, 2.3–2.7 mm. wide; pod 6–10 mm. long, 3–5 mm. in diameter, fully bilocular, villous-hirsute with hairs over 1 mm. long; ovules 12–16.—Collections: 9 (o); representative: *Jones* 26,431 (MO, POM); *E. J. Palmer* 30,726 (MO); *Hinckley* 2699 (MO, NY, SMU, SRSC); *F. P. Matthews* 6705 (NY).

Open, gravelly hillsides and rocky stream beds, in volcanic soils, 5000–6350 feet, uncommon, known only from Jeff Davis and Presidio Counties, trans-Pecos

Texas (Davis Mountains; Marfa; Chinati Mountains and vicinity).—Map No. 99.—April to July.

ASTRAGALUS MOLLISSIMUS var. *MARCIDUS* (Greene ex Rydb.) Barneby ap. B. L. Turner, Legum. Tex. 191. 1959, based on *A. marcidus* (withering-persistent, of the petals) Greene ex Rydb. in N. Amer. Fl. 24: 446. 1929.—“Type collected in the Davis Mountains, Texas, April 28, 1902, Tracy & Earle 319...”—Holotypus, NY! isotypi, G, GH, MO, ND, TEX, US!



Map No. 99. Utah, Colorado, Arizona, and New Mexico. Range (in part) of *A. mollissimus*: var. *Bigelovii*; var. *marcidus*; var. *mogollonicus*; var. *Matthewsii*; and var. *Thompsonae*.

The var. *marcidus* is a comparatively rare form. It is evidently close to var. *Bigelovii*, having the same long vesture of loosely spreading hairs and the fully bilocular pod; but the pod and the flower are so strikingly smaller as to give a peculiar aspect to the plant. And no other variety of the woolly locoweed has so few ovules. The marcescent petals are not (as in many Eurasian astragali) attached by their claws to the staminal sheath, but merely tend to linger about the forming pod to which they are appressed by the sheathing calyx, a phenomenon by no means unique to the variety. The records of var. *marcidus* from Chihuahua (Hartman 605) and Coahuila (Palmer 559) listed by Rydberg are wrongly identified. The first is char-

acteristic var. *Earlei*; and the second (with banner about 19 mm. long) seems to represent the more southern var. *iolanus*. In the Davis Mountains the two small-flowered woolly locoweeds, var. *marcidus* and var. *Earlei*, are sympatric, but the latter, by far the commoner, is easily distinguished by its short-pubescent pod unilocular in the beak.

233h. ASTRAGALUS MOLLISSIMUS VAR. MOGOLLONICUS

Acaulescent, commonly dwarf, the stems reduced to thick crowns closely invested with stipules 5–12 mm. long, the herbage very densely, finely, and loosely villous-tomentose, the vesture at first silvery-canescens, rusty when dried, the longest, widely spreading or retrorse hairs up to 2–3.5 mm. long; *leaves* (4) 6–16 cm. long, with (9) 13–23 broadly elliptic to suborbicular leaflets 3–13 mm. long; *peduncles* 4–10 cm. long, scapiform; *racemes* ovoid-oblong, densely 12–32-flowered, the axis 1.5–6 cm. long in fruit; *calyx* 10–15.3 mm. long, the tube 6.6–8.5 mm. long, 3.2–5 mm. in diameter, the teeth 3.3–6.8 mm. long; *petals* pink-purple; *banner* 16–21.5 mm. long; *wings* 15–19.8 mm. long, the claws 7.4–9.2 mm., the blades 8.6–12.3 mm. long, 2.2–3.4 mm. wide; *keel* 12.3–14.7 mm. long, the claws 7.5–9.2 mm., the blades 5.2–6.8 mm. long, 3–3.7 mm. wide; *pod* narrowly ovoid or lunately ellipsoid, nearly straight to gently incurved, 9–13 mm. long, 4.5–6 mm. in diameter, the valves densely villous-tomentose, the longer hairs up to 1.6–2.6 mm. long, the beak fully bilocular; *ovules* 19–28. —Collections: 12 (iii); representative: *Eggleston 17,189* (NY); *Ripley & Barneby 5220, 8464* (CAS, RSA); *Cutler 2125* (CAS); *C. L. Hitchcock 19,042* (WS).

Stony flats and hilltops, commonly in thin, pebbly, volcanic soils of open yellow pine forest, occasionally on limestone, and descending to rocky knolls in the piñon-juniper belt, 6200–7500 feet, apparently not common, Kaibab Plateau south of the Grand Canyon, Arizona, southeast through the Flagstaff Plateau and (perhaps interruptedly) along the Mogollon Escarpment into Catron and McKinley Counties, New Mexico.—Map No. 99.—(April) May to July.

ASTRAGALUS MOLLISSIMUS VAR. MOGOLLONICUS (Greene), comb. nov., based on *A. mogollonicus* (of the Mogollon Mountains) Greene in Bull. Torr. Club 8: 97. 1881 ("Mogollonicus"). —"Bleak grassy summits of the middle elevations of the Mogollon Mountains in New Mexico, flowering in April, 1881."—Holotypus, ND! isotypus (fragment), NY!—*A. Bigelovii* var. *mogollonicus* (Greene) Barneby in Leaf. West. Bot. 4: 60. 1944.

Astragalus Bigelovii fma. *MacDougalii* (Daniel Trembly MacDougal, 1865–1958, plant physiologist and collector) Gand. in Bull. Soc. Bot. Fr. 48: xiv. 1902.—"MacDougal Pl. of Arizona exs. No. 128... Hab. Arizona, ad Flagstaff (Dr. D. MacDougal)." —Holotypus, petend. in herb. Gand.; isotypi, ARIZ, NY!

The Mogollon woolly locoweed is a highly decorative plant, reminiscent of some dwarf, canescently long-villous *Oxytropis* in its acaulescent growth-habit and scapiform peduncles. It is distinguished from var. *Bigelovii*, which is nearly always caulescent, by its lower stature and smaller leaves, leaflets, flowers, and pods, differences which would be trifling enough except for the disjunct ranges of dispersal and the pronounced differences in life-zone and ecology. The extremely fine, copious, spirally twisted villi of the stem and herbage reach greater lengths in var. *mogollonicus* than in any other form of the species.

Over most of its range var. *mogollonicus* is the sole representative of the woolly locoweed, for it occurs only around the extreme southern edge of the Colorado Basin at elevations above the limit of var. *Thompsonae*. In the pine forests of McKinley County, New Mexico, it overlaps or very closely approaches var. *Matthewsii*, which differs chiefly in its few-flowered racemes and plumply ovoid, turgid pod, 7–13 rather than 4.5–6 mm. in diameter.

233i. ASTRAGALUS MOLLISSIMUS VAR. MATTHEWSII

Acaulescent or nearly so, the stems not over 1.5 cm. long, concealed by imbricated stipules (3) 4–8 mm. long, the herbage villous with loose hairs up to 1–2 mm. long, silvery-canescens or greenish; *leaves* (3) 5–12 cm. long, with 11–23 obovate leaflets 3–12 mm. long; *peduncles* scapiform, (1.5) 2.5–8 cm. long; *racemes* (5) 7–12-flowered, the axis (0.5) 1–4.5 cm. long in fruit, not or scarcely

surpassing the foliage; *calyx* 10–13 mm. long, the tube 7–8.6 mm. long, 3.4–4.7 mm. in diameter, the teeth 2.4–5.2 mm. long; *petals* pale purple; *banner* 18.5–22.5 mm. long; *wings* 16.8–20.3 mm. long, the claws 8.4–10.7 mm., the blades 9.4–11.1 mm. long, 2.7–3.1 mm. wide; *keel* 14.2–18 mm. long, the claws 8.7–11.5 mm., the blades 6–7.5 mm. long, 3.5–3.9 mm. wide; *pod* broadly and plumply ovoid, widest near the obtuse or truncate base, 12–18 mm. long, turgid and 7–13 mm. in diameter, gently or rather abruptly incurved distally into the conical, obscurely compressed, fully bilocular beak; *ovules* 24–31.—Collections: 8 (iii); representative: *Eastwood* 5652 (CAS); *Ripley & Barneby* 5258, 8421 (CAS, RSA); *Castetter* 6028, 6029 (NMEX); *Hinckley* 4383 (SRSC).

Open slopes and hilltops, mostly in yellow pine forest, but descending along canyons into the juniper-piñon belt, in light sandy or gravelly, sedimentary, granitic, or volcanic soils, 6550–8300 feet, uncommon and scattered in the mountains of northwestern New Mexico (Zuñi Mountains, McKinley County; Jemez Mountains, Sandoval County; near Santa Fe, Santa Fe County), apparently intergrading in Sandoval County with var. *Thompsonae*.—Map No. 99.—April to June.

ASTRAGALUS MOLLISSIMUS var. *MATTHEWSII* (Wats.), comb. nov., based on *A. Matthewsii* (Washington Matthews, 1843–1905, ethnobotanist and archeologist, U. S. Army surgeon stationed at Fort Wingate in 1882) Wats. in Proc. Amer. Acad. 18: 192. 1883.—“At Fort Wingate, New Mexico; collected by Dr. W. Matthews, U. S. A.”—Holotypus, (*Matthews* 11, in 1882), GH! isotypi, NY, P, US!—*A. Bigelovii* var. *Matthewsii* (Wats.) Jones, Rev. Astrag. 231, Pl. 58. 1923.

The Matthews woolly locoweed, the last of the four forms of *A. mollissimus* with pod bilocular up to the apex of the beak, closely resembles both the last, var. *mogollonicus*, in stature, although easily distinguished by its tumid fruit of plump outline and few-flowered racemes, and the next in order, var. *Thompsonae*, with which it intergrades on and near the Continental Divide in Sandoval County. Characters ordinarily and ideally distinguishing var. *Matthewsii* from var. *Thompsonae* are the dwarfer growth-habit, fewer flowers, and pod with much less pronounced, less incurved, and fully bilocular beak. The calyx-teeth of var. *Matthewsii* are either longer or at least longer relative to the tube than in var. *Thompsonae*, but the flowers are otherwise nearly identical. The present variety thus serves as a bridge linking the group of races typified by var. *Bigelovii* with the relatively distant var. *Thompsonae* of the Colorado Basin. Some phases of the southern and central Mexican var. *irolanus* have pods as plumply turgid as those of var. *Matthewsii*, but the beak is there unilocular, and the 23–33 leaflets larger and more numerous.

233j. *ASTRAGALUS MOLLISSIMUS* var. *THOMPSONAE*

Acaulescent or nearly so, the stems not over 3 cm. long, mostly concealed by imbricated stipules (4) 5–12 (15) mm. long, the herbage densely villous-tomentose, the longest hairs up to 1–1.8 mm. long; *leaves* (3) 5–17 (20) cm. long, with (15) 19–31 (35) obovate to suborbicular, obtuse or retuse leaflets 3–14 (18) mm. long; *peduncles* (3) 4–15 (19) cm. long; *racemes* (7) 12–25-flowered, the axis (1.5) 2–12 cm. long in fruit; *calyx* 11–12.5 (14.2) mm. long, the tube 7.7–10 (11.2) mm. long, 3.7–4.6 mm. in diameter, the teeth 2–3.5 (4) mm. long; *petals* pink-purple; *banner* 18–22 (24.5) mm. long; *wings* 17.5–21 (24.5) mm. long, the claws 9–11 (12.5) mm., the blades 9.4–11.5 (13) mm. long, 2.2–3.1 mm. wide; *keel* 15–8.5 (20.5) mm. long, the claws 9–11.5 (12) mm., the blades 6–7.6 mm. long, 2.8–3.6 mm. wide; *pod* obliquely ovoid, broadest near the base, 11–23 mm. long, 6–11 mm. in diameter, abruptly incurved near the middle through nearly a right angle into a well-defined, deltoid-acuminate, laterally compressed, unilocular beak, the valves densely villous-tomentose, the longest spreading hairs up to (1.2) 1.5–2 mm. long; *ovules* 28–38 (41).—Collections: 61 (xx); representative: *Train* 2619 (NA, NY); *Jones* 5201 (NY, POM); *Eastwood & Howell* 9281 (CAS, RSA); *C. L. Porter* 5302 (CAS, NY, TEX); *W. A. Weber* 3841

(CAS, TEX, WS); *J. T. Howell 24,512* (CAS, RSA); *Ripley & Barneby 8361* (RSA, UTC).

Dry hillsides, mesas, canyon benches, and gullied slopes at the foot of cliffs and buttes, in sandy or sandy-clay soils derived from shale or sandstone, commonly with junipers, 4650–6750 (in the Grand Canyon descending to 2500) feet, widespread and locally common in the Colorado Basin, from the south foothills (and Flaming Gorge on the north slope) of the Uintah Mountains through eastern Utah to southwestern Colorado and northern Arizona, extending west across the Virgin to the Muddy River in southeastern Nevada, and southeast across the San Juan-Rio Grande Divide to the upper Rio Puerco in northwestern New Mexico, there apparently passing into var. *Matthewsii*.—Map No. 99.—April to June.

ASTRAGALUS MOLLISSIMUS var. *THOMPSONAE* (Wats.), comb. nov., based on *A. Thompsonae* (Mrs. Ellen P. Thompson, resident at Kanab, Utah, during the summer of 1872 while her brother, Capt. J. W. Powell, was engaged on the survey of the Grand Canyon of the Colorado) Wats. in Proc. Amer. Acad. 10: 344. 1875.—“Collected in Southern Utah on Col. Powell's Expedition, by Mrs. E. P. Thompson and Capt. F. M. Bishop.”—Cotypi, mounted together, labeled: “S. Utah, F. M. Bishop, 1873” (fl. & fr.), and “Kanab, Utah, Mrs. E. P. Thompson, 1872” (fr. only), GH! isotypus, *Bishop*, dated “1872,” US!—*Tragacantha Thompsonae* (Wats.) O. Kze., Rev. Gen. 948. 1891 (“*Thomsonae*”). *Astragalus Bigelovii* var. *Thompsonae* (Wats.) Jones, Contrib. West. Bot. 8: 23. 1898. *A. syrticolus* (dwelling in quicksand) Sheld. in Minn. Bot. Stud. 1: 22. 1894, a superfluous substitute, the supposed obstacle, *A. Thomsonianus* Bth., being different both in root and form.

Thompson's woolly locoweed is generally very distinct within its species, and constitutes by itself a third major division of *A. mollissimus* coordinate with the groups of forms revolving around var. *mollissimus* and var. *Bigelovii*. Its pod combines the unilocular beak of the first group with the copious loose vesture of the second, but its individual facies results from a number of small features. Chief among these are the very short or obsolete stems, a calyx proportionately longer and narrower, leaflets on the average smaller and of rounder outline, and pod more strongly inflated and further incurved than in most other forms of the species. Also, the silvery-canescens vesture, unlike that of the other woolly locoweeds which turns rusty a few weeks or a few years after drying, remains permanently unchanged in color. Were it not for the difficulty encountered in separating var. *Thompsonae* from var. *Matthewsii*, where their ranges touch in northwestern New Mexico, it would doubtless deserve specific status.

Along the San Juan River from the Four Corners to Aztec and south to the Chaco Canyon, var. *Thompsonae* is locally abundant and characteristic of its sort, easily distinguished from var. *Matthewsii* by its more numerous leaflets, longer-pedunculate racemes of more numerous flowers, and pod strongly incurved into a prominent unilocular beak. However, as the traveler passes southeastward across the Continental Divide to the head of the Rio Puerco in Sandoval County, he will encounter puzzling populations in which the differential characters, either severally or together, are blurred or diminished, and individual plants (cf. *Ripley & Barneby 8350*; *Barneby 12,806*, RSA) lean now to one and now to the other variety, showing the entities to be confluent in this area.

In favorable seasons var. *Thompsonae* is a beautiful astragalus, one which is to be expected anywhere on the red or white sandstones of the Colorado Plateau. The individual plant is sometimes greatly reduced in stature during years of scanty spring rainfall, but it starts so early into blossom that a few pods even then will reach maturity, an advantage which is shared by few herbaceous plants of the interior deserts other than some deeply rooting astragali and asclepiads. Normally white-pubescent, the calyx is occasionally villous with fuscous or black hairs which furnish a striking contrast to the silvery foliage and a handsome foil to the purple petals. Such black-hairy forms seem commonest along the foot of the Zion Escarpment in Utah, but occur sporadically in northwestern New Mexico and elsewhere. In the Zion region the calyx is commonly bracteolate.

LIX (ii). Subsectio ORTHANTHI

Flowers scarlet, very long and narrow, the almost erect, entire and acute banner 2.5–3.3 cm. long; wings and keel both acute, the blades of the latter sharply triangular at apex.—Sp. 1, xerophyte, of the Orizaba massif, Puebla and Vera Cruz.

ASTRAGALUS sect. *MOLLISSIMI* subsect. *ORTHANTHI*, subsect. nov., a *Mollissimis* genuinis

flore longissimo angusto, petalis coccineis omnibus acutis, vexillo suberecto absimiles.—*Sp. unica*: *A. Helleri* Fenzl (*A. orthanthus* Gray).

234. ASTRAGALUS HELLERI

Robust, bushily tufted perennials, with stout taproot and stems at length indurated at base, densely silky-tomentose with shorter, curly, and longer, ascending, spirally twisted hairs up to 0.8–1.3 mm. long, the herbage white when fresh but the vestiture turning rusty when dry; *stems* several or numerous, diffuse or ascending, up to 2 dm. long, branched or spurred at several nodes below the middle or almost simple, densely leafy, the internodes usually not much over 1–2 cm. long; *stipules* 3–10 mm. long, broadly triangular-apiculate or lanceolate, semi-amplexicaul-decurrent, densely pubescent dorsally; *leaves* 8–25 cm. long, with thick, ultimately stiff petioles and (19) 23–35 obovate-elliptic, or oval, obtuse or penicillate-acute, flat or loosely folded leaflets 4–12 mm. long; *peduncles* stout, erect or incurved-ascending at anthesis, apparently reclinate in fruit, up to 16 cm. long; *racemes* shortly but loosely 10–20-flowered, the flowers ascending, the axis 3.5–7 cm. long in fruit; *bracts* firm, lanceolate, 2–5 mm. long; *pedicels* ascending, at anthesis 1–2.5 mm., in fruit greatly thickened and up to 5 mm. long; *bracteoles* 0; *calyx* 12.5–18 mm. long, densely tomentose like the foliage, the subsymmetric disc 2–2.5 mm. deep, the cylindric, reddish tube 8.5–13 mm. long, 4–4.5 mm. in diameter, the subulate or lance-subulate teeth 2.5–6 mm. long, the whole becoming papery, ruptured, but apparently not circumscissile; *petals* scarlet, drying crimson; *banner* nearly erect, oblanceolate, 25–33 mm. long, 6–8 mm. wide, the midvein running out at the acute apex as a mucro about 0.5 mm. long; *wings* 23–28 mm. long, the claws 13–17 mm., the narrowly lanceolate, acute, nearly straight blades about 11–12.5 mm. long, 1.5–3 mm. wide; *keel* 22–27 mm. long, the claws 14–18 mm., the oblong, acute, slightly incurved blades 9–11 mm. long, 2–3 mm. wide; *pod* (seldom seen) somewhat obliquely oblong-ellipsoid, at least 2.5 (reportedly up to 5) cm. long, 1 cm. or more in diameter, broadly cuneate or rounded at base, contracted at apex into a short point, a little obcompressed, sulcate dorsally, the slightly fleshy, at length stiffly papery, stramineous, reticulate valves densely tomentulose, inflexed (through the pod's lower $\frac{2}{3}$) as a complete septum at least 3 mm. wide; *ovules* $\pm$ 29–36; *dehiscence* and *seeds* unknown.—Collections: 4 (o); representative: *Liebman* 4683 (US); *Balls & Gourlay* 4462 (K, NY, US); *Purpus* 11,108 (MICH, NY).

On dry banks among rough grasses and shrubs, on volcanic sandy hillsides, sometimes at the edge of pine woods, 7000–10,400 feet, apparently quite local, known only from the slopes of Mt. Orizaba and vicinity, Puebla and Vera Cruz.—Map No. 100.—April to September.

ASTRAGALUS HELLERI (Carl Bartholomaeus Heller, 1824–1880, collected in Mexico 1845–48) Fenzl in *Bonplandia* 6: 56. 1861.—“Am trachytischen Sandbogen am Westabhang der Cordillera des Orizaba zwischen 9–10,000' uber d. M., unweit des Rancho Canoitas auf dem selten betretenen Gebirgspass, welcher von Capilla nach Achilchotla fuhrt . . . Heller, Pl. Mex. 236.”—No typus examined, but the description of the long scarlet flower and tomentose vestiture decisive.—*Tragacantha Helleri* (Fenzl.) O. Kze., *Rev. Gen.* 945. 1891.

Astragalus orthanthus (with straight flowers) Gray in *Proc. Amer. Acad.* 6: 195. 1864. “Mexico, near Perote, on sandy hillsides, Dr. Halstead, in herb. Torr.”—Holotypus, NY! isotypus (*Halstead* 19), K!—*Tragacantha orthantha* (Gray) O. Kze., *Rev. Gen.* 947. 1891.

Astragalus erythrostachys (with red flower-clusters) Ulbrich in *Notizbl.* 3: 192. 1902.—“Mexiko: zwischen Perote und Tezintlan am Rande eines Kiefernwaldes in 2700 m Meereshöhe (Preuss no. 1423—fl. June); Fetela Xonotla (Ehrenberg (leg. Schmitz) no. 871—fl. et fr.)” —No typus examined, but the ample description decisive.

The Orizaba milk-vetch, *A. Helleri*, is a spectacular astragalus. In habit of growth the species closely resembles some of the more robust, caulescent phases of *A. mollissimus*, but the greatly elongated flower with its narrow, acute, almost erect petals is most distinctive. In

fact, the flowers suggest an *Erythrina* in their peculiar shape and brilliant scarlet coloring, and are shown off to the greatest possible advantage by the dense, silky-tomentose vesture of the stems and leaves. In a note on the red-flowered Mexican species (Barneby, 1956, p. 501) *A. Helleri* was associated with *A. sanguineus*, and it was suggested that the two species formed a section of their own. The arrangement seemed a natural one, but at the time the pod of *A. Helleri* was known only from immature specimens and from descriptions of plants cultivated in Europe. Fenzl likened the pod to that of *A. mexicanus* (our *A. crassicaupus* var. *Berlandieri*), and I wrongly assumed that, like that of *A. sanguineus* and other *Sarcocarpis*, it was succulently fleshy becoming pithy when ripe. As shown by examples collected recently by Balls & Gourlay (cited above), the pod is in reality of quite thin texture, becoming stiffly papery when mature. Thus, except for the long, red flower, *A. Helleri* has every character, including the characteristic pubescence which tarnishes on drying, of sect. *Mollissimi*, whereas *A. sanguineus*, granted the same reservation about the flower, is a typical member of sect. *Sarcocarpis*. Apparently these two Mexican species and the Californian *A. (Argophylli) coccineus* have arisen independently from three separate evolutionary branches of the genus. It is remarkable that the modification in flower-color has occurred in each along with a modification of the petal-shape. In all three species the scarlet petals are held nearly erect out of the calyx, forming the nearest approximation to a tubular perianth which the papilionaceous flower can acquire. They are typical hummingbird flowers, but whether birds play any role in their fertilization is unknown.

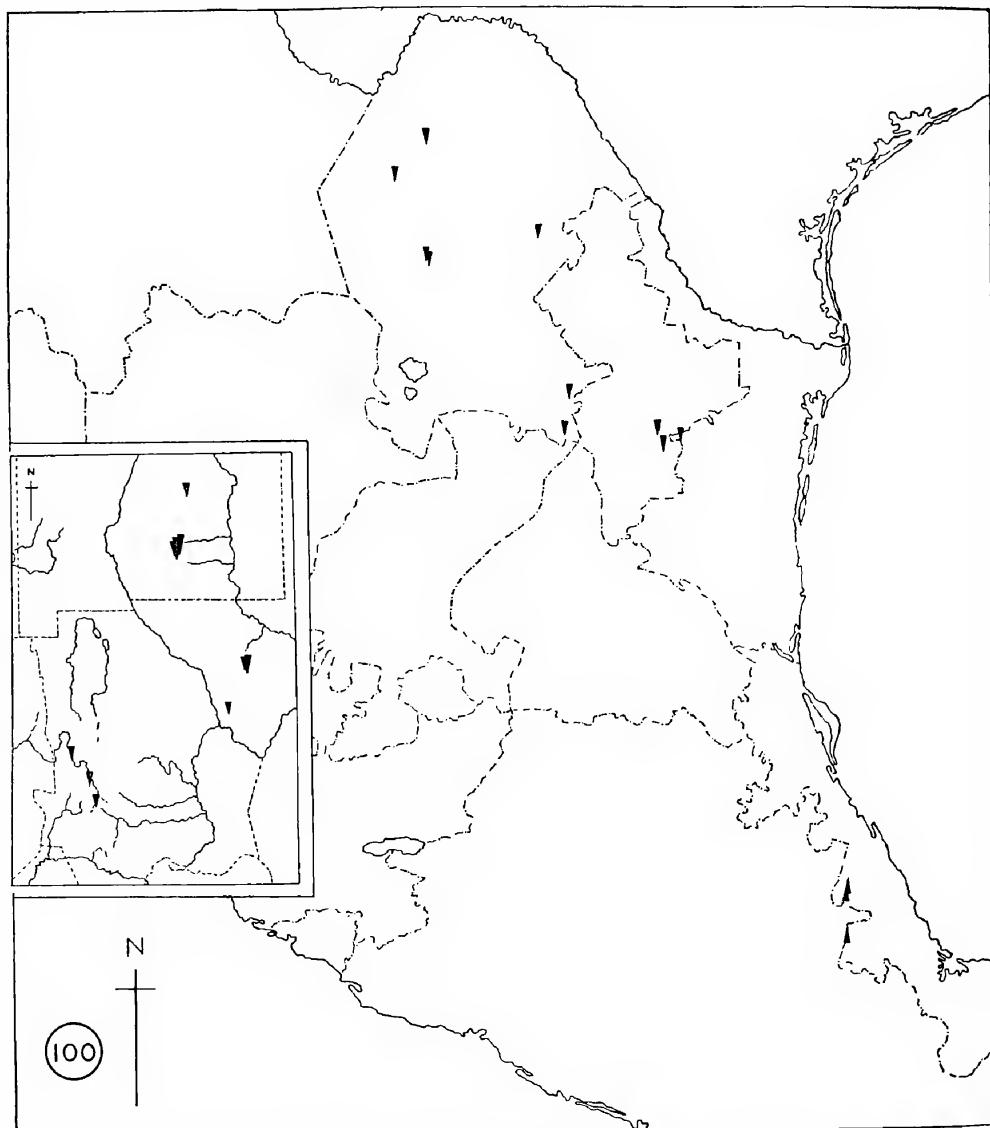
No authentic material of *A. Helleri* or *A. erythrostachys* has been examined, but the descriptions are unusually full and explicit, the tomentose pubescence of the leaves and the distinctive shape, color, and great length of the petals being stressed. All three names cited in the synonymy were based on plants collected on the slopes of Mt. Orizaba, and there can be no reasonable doubt that they refer to the same species. The foregoing description will need amplification as more is learned about variation in the fruit. Fenzl described it as reaching a length of two inches (± 5 cm.), about twice as long as any found in American herbaria today.

LX. Sectio GIGANTEI

Coarse, erect, caulescent perennials, with superficial root-crown; *vesture* basifixed, pilose and tomentulose; *stipules* free; *leaves* imparipinnate, with 17–35 leaflets; *flowers* numerous, rather densely racemose, declined at full anthesis, the banner about 15–21 mm. long; *pedicels* becoming erect, thickened, elongate, persistent; *calyx-tube* deeply campanulate or cylindric, finally circumscissile and deciduous; *petals* pale yellow, regularly graduated, the keel-tip obtuse; *pod* erect, sessile, long-persistent on the receptacle, ovoid- or ellipsoid-acuminate, slightly incurved, turgid but somewhat obcompressed, the fleshy valves becoming leathery, inflexed as a complete or subcomplete septum; *dehiscence* apical, the beak gaping to release the seeds; *ovules* 28–45.—Sp. 1, mesophyte, flowering in summer and fall, of central New Mexico, trans-Pecos Texas, and Chihuahua.

ASTRAGALUS sect. GIGANTEI, sect. nov., stipulis magnis, pubesque duplici e pilis brevioribus cum longissimis spiraliter tortis constituta *Mollissimos* similes sed caulibus racemisque erectis, floribus nutabundis, necnon legumine erecto diu persistenti graviter dispares.—Sp. unica: *A. giganteus* Wats. (in serie piptoloboidea legumine haud deciduo notabilis).

It was assumed by Jones (1923, p. 233) and by Rydberg (1930, p. 539) that the affinities of the giant milk-vetch, the striking monotype for which a separate section is here proposed, lie with *A. mollissimus*, which shares its peculiar pilose-tomentulose vesture composed of shorter, curly mixed with longer, straighter, spirally twisted hairs; but except for the free, large, and rather firm stipules and bilocular pod, *A. giganteus* has few important traits in common with the woolly locoweeds. The nodding flowers, giving rise to erect, persistent pods, are technically more in harmony with the *Reventi-arrecti*, or even with *A. neglectus* (with which Sheldon, 1894, p. 141, associated it in his odd little sect. *Araneocarpus*), as is also the erect habit of growth. There is no particular species of the *Reventi-arrecti* which can be singled out as suggestive of a direct relationship with *A. giganteus*; and I am obliged to concede that the type of pubescence remains the most persuasive clue to the probable systematic affinities of an astragalus no doubt greatly modified morphologically *pari passu* with its adaptation to a mesophytic habitat and estival anthesis. The role that *A. giganteus* may have played in the genesis of *A. (Argophylli) neomexicanus* is discussed under the latter heading.



Map No. 100. Central and northeastern Mexico. Range of ▼ *A. sanguineus*; and of ▲ *A. Helleri*; and, inset, left, parts of New Mexico, trans-Pecos Texas, and Chihuahua. Range of ▼ *A. giganteus*.

Here defined as a monotypic section, the *Gigantei* may need in the future to be extended to accommodate *A. Hartmanii*, a species known only from the flowering type-collection and thus of uncertain relationship. Somewhat similar in character, but differing in its extremely large leaflets, thinner vesture, and long, narrower flower (banner over 3.5 cm. long), it may belong to sect. *Mollissimi*. The plant is described in detail in Appendix I.

We have no report as yet that *A. giganteus* is a locoweed; it is, in any case, too scarce a plant to cause much trouble.

235. *ASTRAGALUS GIGANTEUS*

Robust, amply leafy, with a thick, woody taproot, densely tomentulose and pilose throughout with shorter, curly or sinuous, and longer, nearly straight, spirally twisted, loosely ascending hairs up to 1.3–2.5 mm. long, the herbage silky-canescenscent or greenish in age, the vesture tending to turn rufous or rusty when dry; *stems*

solitary or few together (rarely several in a clump), stout (4–9 mm. in diameter just above the root-crown), erect or stiffly ascending, (0.7) 2–6 dm. long, simple or shortly spurred below the middle; *stipules* herbaceous becoming dry but firm, broadly to narrowly deltoid, triangular, or lance-acuminate, 6–17 mm. long, $\pm$ semiamplexicaul-decurrent, densely silky-pilose dorsally; *leaves* (9) 13–35 cm. long, with stout, rather short petioles and 17–35 broadly to narrowly elliptic, ovate, oblong- or rhombic-elliptic, acute or abruptly short-acuminate, often callous-mucronulate, flat leaflets (0.7) 1–5.5 cm. long, all carinate dorsally by the prominent, pale, densely pilose midrib, the larger ones distinctly pinnate-veined; *peduncles* stout, erect, (0.8) 1–2.7 dm. long, either a little longer or shorter than the leaf; *racemes* at first rather closely (15) 20–55 (65)-flowered, the flowers ascending in bud, early horizontal and at length declined, the axis somewhat elongating, (3) 5–20 (24) cm. long in fruit; *bracts* lance- or linear-acuminate, 2–6 mm. long, scarious-margined, densely pilose; *pedicels* at first ascending, becoming arched outward or recurved and then again erect in fruit, at anthesis (1.2) 1.5–4 mm., in fruit (3) 4–9 mm. long; *bracteoles* 0; *calyx* (7.8) 10–14.7 mm. long, silky-pilose or tomentulose with pale hairs, the somewhat oblique disc 1.3–1.7 mm. deep, the deeply campanulate or subcylindric tube (6) 7–8.7 mm. long, (3) 3.3–5.1 mm. in diameter, the lance-acuminate or linear-lanceolate teeth 3–6.5 mm. long, the whole becoming papery, circumscissile at base, leaving the pod naked; *petals* pale yellow, immaculate; *banner* gently recurved through $\pm$ 45° (or further in fading), oblanceolate-spatulate or rhombic-elliptic, (14.4) 15.5–21.5 mm. long, (6.4) 6.7–10 mm. wide, shallowly notched; *wings* (12.4) 14.3–19.5 mm. long, the claws 6.8–9.6 mm., the linear-oblong or narrowly lanceolate, obtuse or subtruncate, nearly straight blades (7.6) 8–11.4 mm. long, 2–3.1 mm. wide; *keel* (11.5) 12–15.1 mm. long, the claws (7) 7.5–9 mm., the half-obovate or lunately half-elliptic blades (5.6) 5.8–7.1 mm. long, (2.2) 2.5–3.7 mm. wide, rather abruptly incurved through 85–90° to the bluntly deltoid apex; *anthers* (0.6) 0.65–0.9 mm. long; *pod* stiffly erect, sessile, plumply ovoid- or ellipsoid-acuminate, 1.5–2.5 cm. long, 8–13 mm. in diameter, slightly incurved, rounded or subtruncate at base, contracted distally into a short, triangular-acuminate, laterally compressed, unilocular beak, otherwise turgid but a little dorsiventrally compressed, flattened or shallowly sulcate dorsally (but the sinuous suture prominent), more deeply open-sulcate ventrally toward the middle, the green, fleshy, glabrous valves becoming stiffly leathery, brownish-stramineous and ultimately blackish, faintly cross-reticulate and sometimes also wrinkled lengthwise, inflexed below the beak as a complete or subcomplete septum (1.5) 2–5 mm. wide; *seeds* brown or black, smooth but dull, 1.9–2.6 mm. long.—Collections: 27 (o); representative: *Wootton* 327 (ND, NMC, NY, POM); *Wootton & Standley* 3424 (NMC, WIS, WS); *E. J. Palmer* 30,694 (MO, NY, TEX); *Mueller* 8324 (NY, SMU, RSA); *LeSueur* 679 (CAS, SMU, TEX, US); *Mexia* 2527 (CAS, NY); *Palmer* 295 (NY).

Gravel bars and banks of streams, in pine or oak forest, sometimes coming out onto open but well-watered, grassy banks, hillsides, or weedy roadsides, in volcanic or granitic soils, apparently avoiding limestones, 6000–8000 feet, local: White and Gallinas Mountains, Lincoln and Torrance Counties, New Mexico; Davis and Chinati Mountains, Jeff Davis and Presidio Counties, Texas; west slope of Sierra Madre about the headwaters of Rio Papigochic in Madera, Matachic, and Guerrero Districts, Chihuahua.—Map No. 100.—June to September, flowering exceptionally as early as mid-May.

ASTRAGALUS GIGANTEUS (giant) Wats. in Proc. Amer. Acad. 17: 370. 1882.—“At Fort Davis, Western Texas; Dr. V. Havard, 1881.”—Holotypus (*Havard* 32), GH! isotypus, US!

phototypi, MO, POM!—*A. texanus* (of Texas) Sheld. in Minn. Bot. Stud. 1: 65. 1894, an illegitimate substitute, the supposed obstacle being a later homonym, *A. giganteus* (Pall.) Sheld., 1894.

Astragalus yaquianus (of Yaqui River) Wats. in Proc. Amer. Acad. 23: 270. 1888.—“On moist banks and gravelly bars of the upper Yaqui River at Guerrero, Chihuahua; Pringle (n. 1218), Sept., 1887.”—Holotypus, collected 7 Sept., 1887, GH! isotypi, K, ND, NY, PH, US! phototypus, POM!—*A. giganteus* var. *yaquianus* (Wats.) Jones, Rev. Astrag. 234 (exclus. descr.). 1923. (“*Yaquianus*”).

The giant milk-vetch, *A. giganteus*, is a coarse but handsome astragalus, notable for its ample, densely pilose-tomentulose foliage and well-furnished racemes of nodding, pale yellow flowers succeeded by leathery pods erect on thick, exceptionally long pedicels. The vesture of the leaves is composed of an undercoat of short, curly hairs, mixed with longer, more or less spirally twisted villi, ordinarily straight or nearly so, and spreading at a narrow angle. In Texas and New Mexico the longer hairs are relatively sparse, whereas in Chihuahua they are often, although not quite always, so closely set together as to conceal the under coat, the leaflets becoming silky-pilose. In Texas, the pod is of toughly coriaceous texture; in Mexico and New Mexico, the fruits have thinner, though still leathery walls. Differences of these sorts must be expected when the major populations are greatly isolated, but in *A. giganteus* the modifications seem too slight to deserve taxonomic notice.

As pointed out by Rydberg (1930, p. 539), *A. yaquianus* was misinterpreted by Jones. The latter's description of *A. giganteus* var. *yaquianus* was at least partly based on the plant later described as *A. Hartmanii*, which differs in its much larger flower (banner over 3.5 cm. long); but the accompanying figure (Jones, 1923, Pl. 59) represents the true *A. giganteus* in which the typus of *A. yaquianus* was expressly included. The giant milk-vetch has been needlessly confused in western Texas with the ochroleucous-flowered *A. mollissimus* var. *Coryi*, endemic to the Edwards Plateau at much lower elevations and easily distinguished by its recumbent peduncles, flowers erect or ascending at anthesis, and readily deciduous pod.

LXI. Sectio SARCOCARPI

Caulесcent perennials of moderate or robust stature, with woody taproot and either shallowly or deeply buried root-crown, or a diffusely branching subterranean caudex; *vesture* basifixed; *stipules* mostly free, some lower ones connate in *A. plattensis*; *leaves* imparipinnate, with 15–39 leaflets; *flowers* loosely but often shortly racemose, ascending, widely spreading, or in age a trifle declined, of moderate or large size, the banner 1.6–3.1 cm. long; *pedicels* thickened-persistent; *calyx-tube* deeply campanulate or cylindric, marcescent or circumscissile; *petals* purple, purplish, nearly white except for the maculate keel-tip, or sordid, or (in 1 Mexican species) scarlet, regularly graduated, the keel-tip obtuse; *pod* spreading or ascending, nearly always humistrate, sessile, readily or sometimes tardily deciduous, broadly ovoid, subglobose, or oblong-cylindroid, sometimes broader than long, usually large and always fleshy, terete or somewhat obcompressed, the valves differentiating into a thin endocarp and exocarp separated by a thick, succulent mesocarp composed of large, watery cells drying out to form a fragile pith, the endocarp inflexed as a complete septum; *dehiscence* very tardy, after falling, sometimes only after weathering on the ground, apical, basal, and finally through the septum, thus breaking apart into halves, each closed by half the septum; *ovules* (28) 32–77.

The *Sarcocarpi* or ground-plums are closely related to the *Argophylli*. The flowers are almost identical in form, and there are several examples of genuine *Argophylli* (e.g., *A. Chamaeleuce*, *A. musiniensis*, *A. Shortianus*) in which the mesocarp of the pod has become thickened and succulent and dries out to a pithy texture. But the pod of these *Argophylli* is unilocular. Two subsections of sect. *Argophylli* are characterized by bilocular pods, but these are either triquetrously compressed (as in the *Pseudargophylli*) or, if like those of the *Sarcocarpi* in form and dehiscence (as in the monotypic *Anisi*), then combined with dolabriform vesture. No single differential character of importance serves to distinguish all members of these traditionally accepted groups, the naturalness of which is not, however, in question. The *Mollissimi* differ from the *Sarcocarpi* principally in their peculiar villous- or silky-tomentose

vesture of shorter hairs mixed with longer spiral ones, and the fact that each of these sections has produced one species with a greatly elongated and narrow, scarlet flower is suggestive of a real affinity. The sections already mentioned, together with sect. *Tennesseeenses*, sect. *Megacarpis*, and presumably the aberrantly emmenoloboid *Gigantei*, seem to form a fascicle of evolutionary shoots stemming from a common origin at no great distance in the past. Together they constitute a major element of the North American pitoloboid *Astragali*.

Key to the Subsections of Sect. Sarcocarpis

1. Flowers of moderate or rather large size, the petals purple, purplish, sordid, or white, but never red; *banner* recurved through $\pm 45^\circ$, 16–25 mm. long; s. Canada and United States, s. to centr. and trans-Pecos Texas LXI (i). Subsect. *Sarcocarpis*
1. Flowers large, the petals scarlet, drying crimson; *banner* almost erect, 22.5–31 mm. long; Coahuila and Nuevo León LXI (ii). Subsect. *Sanguinei*

LXI. (i) Subsectio SARCOCARPI

Pod of moderate size, the banner recurved through $\pm 45^\circ$, 16–25 mm. long; *calyx* either circumscissile or persistent.—Spp. 3, xerophytes (but sometimes of rich bottomlands moist in spring), of the Great Plains and east slope of the Rocky Mountains, southern Canada to southern Texas and central New Mexico, east to Wisconsin, Illinois, and the Ozark Highland, 1 extending feebly across the Continental Divide into western Montana and to the edge of the Colorado Basin in eastcentral Arizona.

ASTRAGALUS sect. SARCOCARPI Gray in Proc. Amer. Acad. 6: 192. 1864.—Sp. lectotypica: *A. caryocarpus* Ker = *A. crassicaarpus* Nutt.—*A.* subgen. *Sarcocarpis* (Gray) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 221. 1941.

Astragalus sect. *Carnosocarpus* Sheld. in Minn. Bot. Stud. 1: 171, sine descr. 1894, essentially only a substitute for the last.

Geoprumnon Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903.—Generitypus: *G. crassicaarpus* (Nutt.) Rydb. = *A. crassicaarpus* Nutt.

The genuine *Sarcocarpis* are delimited in these pages along the lines laid down long ago by Gray and adopted by Jones (1923, p. 236) and Rydberg (1926, p. 161, sequ.; 1929, p. 460, sequ.), except only that *A. tennesseensis* has been removed to a separate section for reasons given below. The present treatment is based on an outline already published (Barneby, 1956¹, p. 495, sequ.).

Key to the Species of Sect. Sarcocarpis

1. Ovary and pod (except very rarely in w. Texas) glabrous, the walls of the ripe pod 2–5 mm. thick (if thinner, in centr. New Mexico and e-centr. Arizona, the pod decidedly inflated); *calyx* early becoming scarious, fragile, circumscissile above the disc; *stems* (except in *A. crassicaarpus* var. *Berlandieri* of s.-centr. Texas) arising together from the root-crown or from divisions of a determinate, superficial or shallowly buried root-crown or caudex (2)
2. Pod broadly oblong-ellipsoid or subglobose, $\frac{7}{8}$ –1½ times as long as its greatest diameter; *stipules* glabrous dorsally; *leaflets* commonly glabrous or medially glabrescent above; widespread 236. *A. crassicaarpus*
2. Pod narrowly oblong or oblong-elliptic in profile, 3–4 times longer than wide; *stipules* strigulose dorsally; *leaflets* equally cinereous-strigulose on both faces; local (on gypsum) in s.-e. New Mexico and adjoining Texas 237. *A. gypsodes*
1. Ovary and pod pubescent, the walls of the ripe, solid or scarcely tumid pod less than 2 mm. thick; *calyx* becoming papery but marcescent about the base of the pod; *stems* arising singly or few together from buds on widely branching, subterranean, rhizome-like caudex-branches 238. *A. plattensis*

236. ASTRAGALUS CRASSICARPUS

Of medium or robust stature, with a woody taproot (up to 5 cm. in diameter just below the crown, but usually much less) and several decumbent, ascending, or sometimes suberect stems arising from a determinate root-crown or (in one var.) from slender, subterranean caudex-branches, the herbage variably pubescent, green or cinereous, the leaflets glabrous or medially glabrescent above; *stems* (0.5) 1–6 dm. long, simple or bearing a few spurs or branchlets near the base,

the main axis commonly elongating beyond the last peduncle, the flowering racemes situated above the middle but the fruiting ones at or below the middle of the stems; *stipules* submembranous, pale green, pallid, or purplish, sometimes several-nerved, 3–10 mm. long, the lower ones (sometimes all) ovate or ovate-acuminate, the upper commonly triangular- or lance-acuminate or -caudate, decurrent around $\pm \frac{1}{2}$ the stem's circumference, glabrous dorsally, ciliate, the margins nearly always beset with a few peg- or tack-shaped processes mixed with or even replacing the hairs; *leaves* (2) 3.5–15 cm. long, the upper ones shortly petioled or sessile, with (11) 15–33 broadly oval to linear-elliptic, obtuse or acute, or (in some lower leaves) truncate-emarginate, mostly flat leaflets 3–24 mm. long; *peduncles* (0.5) 2–14.5 cm. long, equaling or commonly shorter than the leaf; *racemes* shortly (5) 7–25 (30), more rarely 20–35-flowered, rather dense at early anthesis, the axis usually somewhat elongating, 1–7.5 cm. long in fruit; *bracts* membranous, pallid or purplish, lance-acuminate or linear-lanceolate, 2.5–7.5 mm. long, often reflexed in age; *pedicels* ascending or a little arched outward, at anthesis slender, 1–2.7 mm. long, in fruit thickened, often clavate, (2) 2.7–7.5 mm. long; *bracteoles* usually present, inserted at base of the calyx or up to 2.5 mm. below it, often conspicuous, rarely rudimentary or 0; *calyx* (6.6) 7.7–13.8 mm. long, the oblique disc (0.8) 1–2.2 mm. deep, the broadly or deeply campanulate, cylindro-campanulate, or rarely cylindric tube (5.2) 5.6–9.7 mm. long, the subulate or triangular-subulate teeth (1.3) 1.7–4.8 mm. long, the ventral pair mostly broadest but either longest or shortest, the whole early becoming scarious, irregularly circumscissile, leaving the pod naked; *petals* purple, lilac, cream-colored, or greenish-white, the keel in any case purple- or pink-tipped; *banner* obovate-cuneate, broadly oblanceolate, rhombic-oblanceolate, or -elliptic, notched, (16) 16.5–25 (27) mm. long; *wings* shorter, the blades linear-oblong, lance-oblong, or narrowly elliptic-oblanceolate, obtuse or sometimes obliquely emarginate, straight or a trifle incurved in the distal half; *keel* (10.7) 12–20.7 mm. long, the blades half-obovate or lunately elliptic, rather abruptly incurved through (80) 85–95° to the blunt apex; *anthers* (0.55) 0.6–0.9 mm. long; *pod* spreading or ascending (humistrate except sometimes in var. *trichocalyx*), sessile, globose, broadly and plumply oblong-ellipsoid, -ovoid, or -obovoid, 1.5–4 cm. long, $\frac{7}{8}$ –1½ times longer than wide, abruptly obtuse or truncate at both ends, or a trifle retuse or umbilicate at apex and there abruptly contracted into a conic-subulate, cusplike beak 1–3 mm. long, the body a little obcompressed, shallowly sulcate or merely depressed along the sutures, the fleshy, glabrous, green but often red-cheeked valves at first firm and succulent (and if dried at this stage collapsing inward and becoming irregularly and coarsely wrinkled, leaving the sutures salient), composed of 3 layers: a thin outer coat and a similar inner one of small cells, these becoming leathery, the outer one eventually brown or blackish and nearly smooth, and a much thicker intervening layer of large cells filled with a sweet juice, this ultimately drying out to a pale, alveolate-spongy or pithy texture, the whole valve-wall 1.2–5 mm. thick (at least near the sutures), the endocarp inflexed across the pulpy-filamentous cavity as a papery septum 8–15 mm. wide, this produced through the valve-wall to unite with or at least to meet the immersed ventral suture; *dehiscence* very tardy, either occurring on the ground by gradual weathering and decay over winter, the exocarp then sometimes separating as a papery shell, the beak splitting but not gaping to release the seeds, or the whole pod splitting through both sutures and the septum and separating into two false carpels; *ovules* 34–77; *seeds* soot-black, smooth or sparsely pitted, dull, (1.9) 2.1–4.4 mm. long.

The varieties of *A. crassicaupus*, all of which (except the newly described var. *cavus*) have been accepted at one time or another as distinct species, differ considerably in degree of dis-

tinctness. Thus var. *crassicaarpus* and var. *Paysoni* are separable only by tenuous differential characters, often difficult to apply to herbarium specimens, and they might be united without any great loss; whereas var. *trichocalyx*, which differs (at least ideally) from var. *crassicaarpus* in growth-habit, pubescence, and especially in ecology, might with reason be retained at the specific level. The var. *Berlandieri*, characterized by a branching caudex below ground, is another striking type in its extreme form. However when allowance has been made for a latitude of variation in the pods no greater than that found in the majority of widely dispersed astragali, the fruit can be considered essentially homogeneous throughout the species, differing from one variety to the next in average but not in absolute size and in the average width of the pod walls.

The status of the name *A. crassicaarpus* is somewhat controversial, being vulnerable to criticism from two directions. The Fraser Brothers' Catalogue has been attacked and defended in recent years (cf. Shinniers, Cronquist & al. in *Rhodora* 57: 290; 58: 23, 281; 59: 100. 1955-1957) as a valid medium of publication, neither side to the question having gained a conclusive victory. A graver fault is the extreme brevity of the original description and the fact that Nuttall himself adopted Pursh's *A. carnosus* in place of his own (or what is presumed to be his own) proposition. However no reasonable doubt has ever been entertained as to the identity of *A. crassicaarpus*, which was already known to botanists contemporary with Nuttall. If Nuttall's name should finally prove unacceptable to the majority, the species must assume the epithet *caryocarpus* Ker (cf. further under var. *crassicaarpus*).

The ground-plum, buffalo-plum, or pomme de prairie is one of the very few American *Astragali* which has acquired a name truly current in the vernacular of the country, due to its value as food. The raw fruit is succulent and sweet but hardly appetizing, although it is said to become more palatable (*T. E. Wilcox*, Fort Niobrara in 1888, NY) after cooking, the boiled pods supposedly tasting like string beans. The fruits are gathered by prairie dogs for their winter store and are attractive to other rodents when ripe and dry. I once found, in a corner of a neglected closet, a hoard of some fifty pods of *A. crassicaarpus* and *A. gypsodes* which had been pilfered from the herbarium by mice and partly devoured. In this respect the pods of the *Sarcocarpi* resemble those of *A. longiflorus* Pall. and probably other members of the appropriately named Old World sect. *Myobroma* Bge.

Key to the Varieties of *A. crassicaarpus*

1. Calyx strigulose, pilosulous, or ascending-pilose with mixed black and white or all black hairs; *petals* purple, lilac, flesh-color, or pure white; *peduncles* mostly short, (0.8) 2-6 (10) cm. long; *plants* of moderate stature, the stems decumbent, 1-4 (5) dm. long; *pod* variable in size, 1.5-3.5 (4) cm. long; widespread over the plains and prairies e. (and locally w.) of the Rocky Mountains, and toward its s.-e. limit, where approaching the range of var. *trichocarpus*, the racemes not over 15-flowered, and the petals (with rare exceptions) bright purple (2)
 2. Stems arising together from the crown of the taproot or shortly forking, determinate caudex at or just below soil-level; if of e. Texas and purple-flowered then the ovules 52-68 (3)
 3. Petals all purple or lilac (disregarding rare albinos); *herbage* bright green (at least below the vesture); mostly e. of longitude 120° and below 4000 ft., the common form of the Prairie States, from Saskatchewan to n.-e. and trans-Pecos Texas 236a. var. *crassicaarpus*
 3. Petals white except for the maculate keel-tip, sometimes suffused with pale pink or flesh-color; *herbage* pallid green or yellowish; mostly w. of longitude 120° and above 3500 ft. (4)
 4. Pod solid (as in var. *crassicaarpus*), the cavity filled with seeds and pulp, the walls of the valves mostly 2.5-5 mm. thick when fully formed; Rocky Mountains and foothills, Colorado n.-ward 236b. var. *Paysoni*
 4. Pod inflated, the cavity much larger than the seeds, the walls of the valves only 1.2-2 mm. thick when fully formed; centr. New Mexico and e.-centr. Arizona 236c. var. *cavus*
 2. Stems arising singly or few together from slender, widely creeping, subterranean caudex-branches, forming loosely matted or colonial growths; *ovules* 34-50; Balcones Escarpment and vicinity, s. Texas 236d. var. *Berlandieri*
 1. Calyx, like the pedicels, densely villosulous-tomentulose (at least at base, commonly throughout) with short, entangled, and some longer, ascending, cream-colored or brownish hairs; *petals* commonly greenish-white or creamy, sometimes suffused with pinkish-lilac; *racemes* 13-25-flowered; *peduncles* 6-16 cm. long; *plants* commonly robust, the stems mostly coarse and fistular, ascending, (2.5) 3.5-6 dm. long; *pod* large, 2.5-3.2 cm. long; Illinois to e. Texas 236e. var. *trichocalyx*

236a. *ASTRAGALUS CRASSICARPUS* var. *CRASSICARPUS*

Of medium stature, the stems decumbent with ascending tips, (0.8) 1–4 (5) dm. long; *herbage* bright or dark green, often cinereous or even silky in youth, the vestiture composed of appressed or narrowly ascending, commonly lustrous hairs up to (0.4) 0.5–1.1 mm. long, the inflorescence pilose or pilosulous with largely or partly black hairs up to (0.45) 0.7–1.2 (1.4) mm. long; *leaves* 3.5–13 (18) cm. long, with (11) 15–29 (31) oblanceolate, elliptic, oblong-elliptic, narrowly obovate-cuneate, or (in some lower leaves) obovate to suborbicular leaflets 3–19 (22) mm. long, up to 2.5–6 (8) mm. wide; *peduncles* (1.5) 2–6 (10) long; *racemes* (5) 7–15 (23), exceptionally 20–35-flowered, the axis mostly 1–3.5 (7.5), exceptionally 4–14 cm. long; *pedicels* 2.7–4.5 mm. long in fruit; *calyx* (6.7) 7.7–11.3 (14) mm. long, the tube (5.2) 5.8–7.8 (8.6) mm. long, (2.5) 3.2–4.4 mm. in diameter, the teeth (1.3) 1.7–4.2 (5.8) mm. long; *banner* (16) 16.5–23.5 (25) mm. long, (7) 8–12.5 mm. wide; *wings* (13.8) 16–18.8 (20.2) mm. long, the claws 6.1–8.5 (9.5) mm., the blades (8.9) 10–12 (12.7) mm. long, (2.1) 2.6–4.1 mm. wide; *keel* (10.7) 12–14.5 (17) mm. long, the claws (5.6) 6–8.5 (9.1) mm., the blades (5.4) 5.8–7.5 (9) mm. long, (2.7) 3–4 mm. wide; *anthers* (0.55) 0.6–0.8 (0.9) mm. long; *pod* globose or plumply ovoid- or obovoid-oblong, 1.5–2.7 cm. long, 1.2–2.5 cm. in diameter; *ovules* mostly 52–68, averaging 60, rarely (in w. Texas) 38–44.—Collections: 252 (vii); representative: *Herriott* 70,468, 70,469 (NY); *Clokey* 3040 (CAS, TEX); *A. & R. Nelson* 929 (RM, SMU, TEX, WIS); *G. T. Robbins* 2326, 2958 (RSA, SMU); *C. & A. Lundell* 8384 (NY, SMU); *B. & H. Jespersen* 2658 (SMU, WIS, WS).

Prairies, rolling plains, old pastures, roadsides, and railroad rights of way, to the south sometimes on calcareous stony hillsides or about oak thickets, widespread and common from the Mississippi Valley west nearly to the foothills of the Rocky Mountains and north into southern Canada, southcentral Alberta to southern Manitoba, south to northeastern and trans-Pecos Texas, east to western (and 1 station on Lake Michigan in eastern) Wisconsin, eastcentral Iowa, western Missouri, and southwestern Arkansas, west to eastern Montana, northeastern Wyoming, eastern Colorado, and eastcentral New Mexico, up to 4450 feet in Colorado and 4500–5800 feet in western Texas, elsewhere mostly below 4000 feet—Map No. 101—Late March (southward) to July, the fruit ripe in summer and fall.

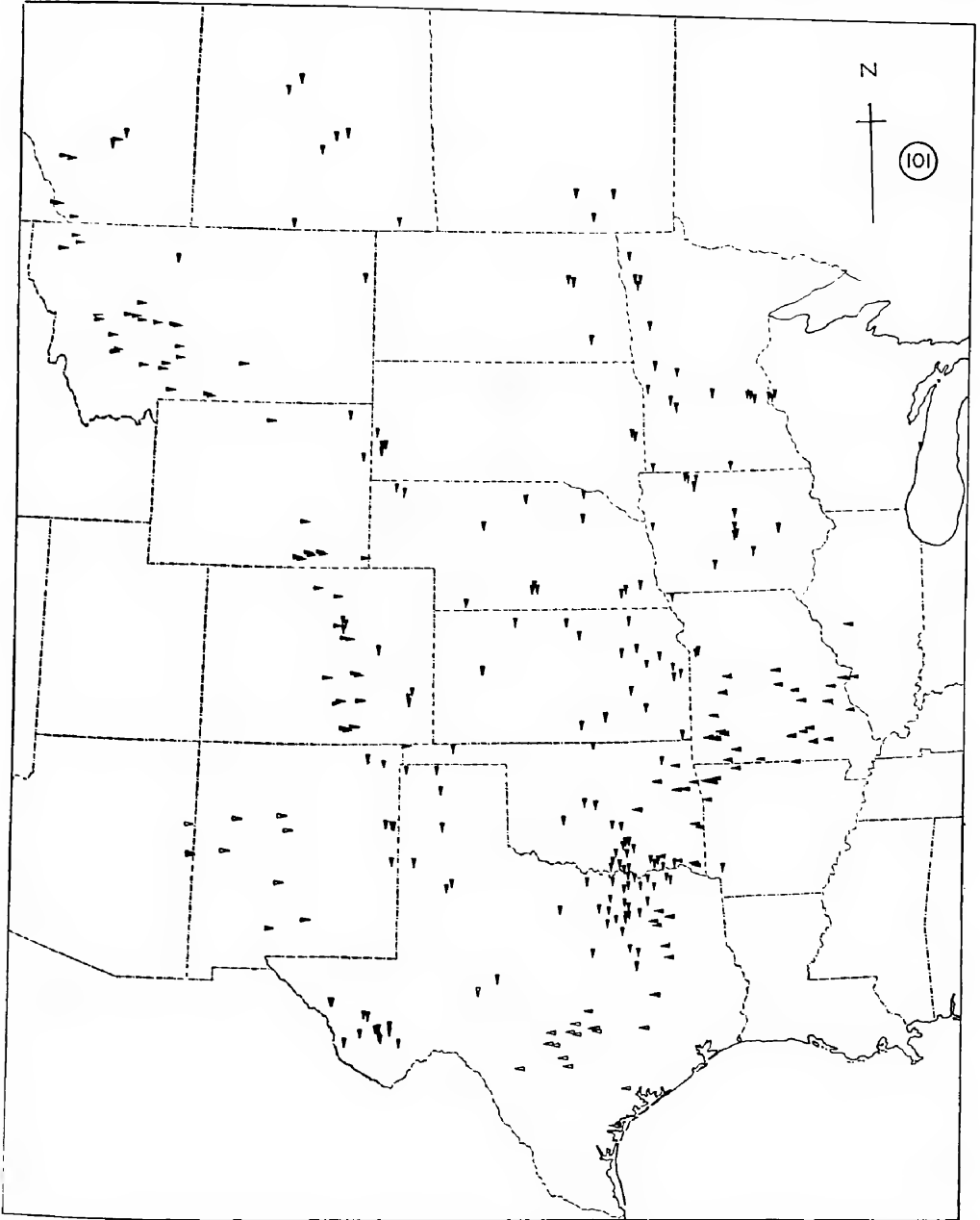
ASTRAGALUS CRASSICARPUS (with thick pod) Nutt. in *Fraser's Cat.*, No. 6. 1813 (reprinted in *Pittonia* 2: 116).—"Collected above the river Platte."—Spm. authent., labeled "Louisiana, Nuttall. *Astragalus crassicaupus*, Fraser's Catalogue of Nuttall's plants. From Lambert's Herbarium," PH (herb. Pursh.)!—*Geoprimum crassicaupum* (Nutt.) Rydb. ap. Small, Fl. S.E. U. S. 1332. 1903.

Astragalus carnosus (fleshy, of the pod) Pursh, Fl. Amer. Sept. 740. 1814, pro parte, as to the fruit only, nom. confus.—"In Upper Louisiana, Bradbury, v. s. in Herb. Bradbury."—The sheet in herb. Pursh. (PH) labeled in Pursh's hand "*Astragalus carnosus*. Louisiana, Bradbury," presumably the holotypus, is entirely *Sophora Nuttalliana* B. L. Turn., to which the protologue (except the fruit) belongs.—*Astragalus carnosus* Pursh emend. Nutt., Gen. 2: 100. 1818.—"On the plains of the Missouri from the confluence of the river Platte to the Mountains."

Astragalus caryocarpus (nut-fruited, the dry pod resembling a small walnut) Ker in Bot. Reg. 2: 176, cum icone. 1816.—"... found in Upper Louisiana by Mr. Nuttall." The description was based partly on plants cultivated in Lambert's garden at Boyton, Wiltshire. No typus examined, but clearly based on the plant introduced by Nuttall and sold by the Fraser Brothers as *A. crassicaupus*.—*Tragacantha caryocarpa* (Ker) O. Kze., Rev. Gen. 943. 1891. *Phaca caryocarpa* (Ker) McMill., Metasp. Minn. Vall. 326, in syn. 1892.

Astragalus succulentus (full of sap, descriptive of the juicy pod) Richards. in Franklin's Journ., Append. 746. 1823.—"sandy plains in the neighbourhood of Carlton."—Holotypus, labeled "Carlton, Richardson," BM! isotypus, *Richardson* 287, K!—The type locality is on the North Saskatchewan River above Prince Albert.—*A. caryocarpus* β Hook., Fl. Bor.-Amer. 1: 150. 1831. *Geoprimum succulentum* (Richards.) Rydb. in Bull. Torr. Club 32: 658. 1905.

The common ground-plum, var. *crassicaarpus*, is now most abundant in the southern part of its range. While it is still fairly frequent on the Great Plains, it is found chiefly along protected rights of way. Doubtless it was more generally distributed northward before the prairie was ploughed, for it is mentioned by nearly all the early travelers, who valued the green fruit as a summer vegetable. The variety is a remarkably adaptable astragalus, equally vigorous on chernozem and red-brown soils, in high-grass or low-grass prairie, on chalky sedimentary formations, alluvia of various composition, or loess. From Kansas southward the flowers are ordinarily bright purple, tending to become paler northward and westward; on the higher prairies the tips of the banner and wings are whitish and the color, as a whole, more fugitive



Map No. 101. The Prairie and Rocky Mountain States and Provinces. Range of *A. crassicaarpus*: $\blacktriangledown$ var. *crassicaarpus* ($\triangleleft$ do., with strigulose pod); $\blacklozenge$ var. *Paysoni*; $\diamond$ var. *cavus*; $\diamond$ var. *Berlandieri*; and $\blacklozenge$ var. *trichocalyx*.

from drying specimens. Albino forms (*Cory* 55,598, SMU) are occasional. The flowers vary considerably in size, but both the largest (*Loring* 3, OKLA) and the smallest (*McCoy* 580, OKLA) so far examined were collected in Oklahoma. The pubescence varies a good deal in length and density, the leaflets in length and width, and the pod in size and outline, but the variation is sporadic and falls into no significant geographic patterns.

Some remarkable forms of var. *crassicaarpus* have evolved in far western Texas. One, distinguished by a strigulose ovary and 1 od, has been collected in the Glass Mountains in Brewster County (*Warnock* 4351, SRSC) and on Edwards Plateau in Irion County (*Barneby* 11,208). Another, known from several gatherings from Ord Mountain south of Alpine in Brewster County, combines a puberulent pod with exceptionally large flowers and long calyx-teeth. Even the glabrous fruiting states of var. *crassicaarpus* in Brewster County, although to all appearances typical of the variety, are unusual because of the few (38–44) ovules. The ground-plums of trans-Pecos Texas seem to be in a state of active evolutionary fragmentation and deserve further study. At the western edge of the variety's range in Quay County, New Mexico, and Kiowa County, Colorado, var. *crassicaarpus* is represented at elevations of about 3800–4500 feet by populations of exceptionally robust plants with relatively long racemes of some 20–35 flowers, the axis becoming 4–14 cm. long in fruit. The raceme is suggestive of *A. gypsodes*, but the pod is characteristic of var. *crassicaarpus*. This form also might repay further observations.

The common ground-plum is a member of the early spring flora, starting into activity with the spring thaw and bearing flowers within a few weeks. The fruits quickly assume their full size, but they require a period of two or three months, or probably longer, to reach full maturity. The majority of herbarium specimens are collected before the tissues of the exocarp have hardened; at this stage the pulpy walls collapse inward in drying, so that the pod appears coarsely and irregularly wrinkled on the sides and girdled lengthwise by a prominent ridge formed by the resistant sutures. In this condition the fruit fulfills Ker's description of the pod of *A. caryocarpus* as being like a "stinted walnut." The sap in the mesocarp of the pods left to dry out naturally on the ground evaporates slowly, leaving intact an empty honeycomb of large, pale-walled cells, and the exocarp does not collapse inward. The truly ripe fruit thus presents an almost smooth exterior, the sutures remaining embedded in the valve walls or becoming, at best, only slightly prominent.

The first three names listed in the synonymy were based on material secured by Nuttall and Bradbury, either together or perhaps independently when traveling up the Platte River, the last partly on plants grown in England from seed supplied by Nuttall through the agency of the Fraser Nursery. Reference has already been made to the controversial status of the name *A. crassicaarpus*. Whether the Fraser Catalogue will be ultimately accepted or not by the majority of botanists cannot be foreseen; however, Nuttall's short, pregnant descriptive phrase, "Fruit about the size and form of *A. physodes*, but thick and succulent," is diagnostic of the common ground-plum when assessed in the light of Plates 58 and 58B of Pallas's *Species Astragalorum* through which, unquestionably, *A. physodes* was known to Nuttall. Pursh's *A. carnosus*, based largely on a *Sophora*, cannot be considered available until emended and typified by Nuttall in 1818; and the fact that Pursh cited *A. crassicaarpus* of Frasers' Catalogue as a probable synonym casts a further shadow of illegitimacy over his proposal. In default of *A. crassicaarpus*, *A. caryocarpus* Ker, dating from 1816, must be the proper name for the ground-plum, and it was adopted as such by Fernald in Gray's Manual (1950, p. 912).

The identity of *A. succulentus* as a form of *A. crassicaarpus* or a close relative was early recognized by Hooker and has gone unquestioned since; it remains only to determine whether it belongs in the synonymy of var. *crassicaarpus* or, as Rydberg assumed, in that of the Cordilleran var. *Paysoni*, equivalent of Rydberg's *Geoprimum succulentum*. Carlton House, the type locality, lies in the prairie belt of the Saskatchewan River well below 2000 feet altitude, offering an environment ideal for typical var. *crassicaarpus*. Furthermore, freshly collected specimens from this region, communicated by Dr. Ledingham of Regina, have pale purple petals with whitish banner- and wing-tips and are identical with the form of var. *crassicaarpus* found in the Dakotas and eastern Montana.

236b. *ASTRAGALUS CRASSICAARPUS* var. *PAYSONI*

Closely resembling var. *crassicaarpus*, differing principally in the paler herbage, strigulose with usually shorter hairs up to 0.35–0.65 (0.75) mm. long, the less densely pilosulous or merely strigulose inflorescence, and the prevailing slightly larger, paler flowers; *stems* (0.5) 1–3.5 dm. long; *leaves* (2) 4–11 (16) cm. long, with 15–25 obovate-cuneate, oval, oblanceolate, or elliptic, obtuse, acute, or rarely truncate-emarginate leaflets 4–16 mm. long, up to 3–7 mm. wide; *peduncles* (1.5) 2–6.5 (8) cm. long; *racemes* (5) 8–20-flowered, the axis (1) 2–7 cm. long in

fruit; *pedicels* (2) 2.8–5.5 mm. long in fruit; *calyx* 9.6–14 mm. long, the tube 7–9.7 mm. long, (3.8) 4–5 mm. in diameter, the teeth (1.9) 2.3–4 (4.4) mm. long; *banner* (18.3) 20–24 mm. long, (8.6) 9–12 mm. wide; *wings* 16.4–20.4 mm. long, the claws 7.2–9.7 mm., the blades 10.4–13.6 mm. long, 2.9–4.7 mm. wide; *keel* (12.6) 13.9–15.9 mm. long, the claws (6.6) 7.4–9.5 mm., the blades 6.5–7.7 mm. long, 3.2–4.1 mm. wide; *anthers* 0.6–0.85 (0.9) mm. long; *pod* as in var. *crassicaarpus*; *ovules* (40) 47–59, averaging ± 52 .—Collections: 49 (vi); representative: *J. Macoun* 18,468 (ND); *Hitchcock & Muhlick* 11,757 (CAS, NY, RSA, WS), 11,857 (CAS, NY, WS), 12,067 (CAS, NY, RSA, WS); *C. L. Porter* 2860 (RM, SMU, TEX, WS, WTU), 4163 (RSA, SMU, TEX); *Ewan* 14,258 (CAS, RSA); *Ripley & Barneby* 10,360 (RSA); *Rydberg & Vree-land* 5992, 5993 (NY).

Prairies, grassy hillsides and open knolls, indifferently on granite, shale, sandstone or limestone, westward often among sagebrush, 3300–8600 feet, widespread and common along the east slope and piedmont of the Rocky Mountains, from southern Alberta to southcentral Colorado, perhaps isolated on Black Mesa at the west tip of the Oklahoma Panhandle, extending feebly west across the Continental Divide to the headwaters of the Flathead River and Clarks Fork in western Montana—Map No. 101.—April to July, the fruit ripe in summer and fall.

ASTRAGALUS CRASSICARPUS var. *PAYSONI* (Kelso) Barneby in Amer. Midl. Nat. 55: 497. 1956, based on *A. succulentus* var. *Paysoni* (Edwin Blake Payson, 1893–1927) Kelso in Rhodora 39: 151. 1937.—“WYOMING: Carbon County, sagebrush slope, Big Creek, road to Encampment, June 30, 1922, Payson & Payson 2514 . . .”—Holotyus, US!

Astragalus prunifer (plum-bearing, the fruit known as ground-plum) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 239. 1900.—“WYOMING: Medicine Bow, 1897, Aven Nelson . . .”—Holotyus, *A. Nelson* 3143, collected June 5, 1897, NY!

In the foregoing key the mountain ground-plum, var. *Paysoni* (= *Geoprumnon succulentum* sensu Rydb., 1929, p. 461 = *A. succulentus* sensu C. L. Porter, 1951, p. 36, non Richards.) has been distinguished from its prairie counterpart by characters of a trivial and superficial nature. Both varieties of *A. crassicaarpus* are variable in pubescence and flower-size. The average plant of var. *Paysoni* is less densely pubescent with shorter hairs, the inflorescence being more often strigulose than pilosulous and, if pilosulous, more shortly so; its flowers are, on the average, a little longer. The pods are identical in outward appearance, but the ovules in var. *Paysoni* are fewer or tend to be so, the number fluctuating around a mean of 52 rather than 60. There is no doubt that two races exist, but no sharp line can be drawn between them, for many collections from a narrow strip along the east base of the Rocky Mountains are quite intermediate in all critical characters and can only be assigned arbitrarily to either category.

236c. *ASTRAGALUS CRASSICARPUS* var. *CAVUS*

Resembling var. *Paysoni* in appearance, the stems decumbent and ascending, 5–30 cm. long, or sometimes short and closely tufted at anthesis, elongating only as the fruit ripens; *herbage* pallid or yellowish-green, strigulose, the hairs up to 0.3–0.6 mm. long, the leaflets glabrous above, the inflorescence strigulose or pilosulous with black or mixed black and white hairs of about the same length; *leaves* (4) 5–15 cm. long, with (13) 17–31 (33) broadly to narrowly elliptic, oval, oblong-ob lanceolate, or (in some lower leaves) obovate, obtuse or subacute, sometimes callous-mucronulate leaflets (2) 4–17 mm. long; *peduncles* 2–9 (11) cm. long; *racemes* 10–23(30)-flowered, the axis (1) 1.5–7 (9) cm. long in fruit; *pedicels* 2–4 mm. long in fruit; *calyx* (8.6) 9.6–12.6 mm. long, the tube (6.3) 7.5–9.2 mm. long, 3.8–4.5 mm. in diameter, the teeth (1.9) 2.3–3.6 mm. long; *petals* whitish, the keel-tip and sometimes the base of the wing-blades, rarely also the base of the banner, faintly lilac-tinged; *banner* 17–25 mm. long, (8.2) 9–14 mm. wide; *wings* 14.4–20.3 mm. long, the claws (6.6) 7–10.4 mm., the blades 8.7–12.7 mm. long, 2.6–3.8 mm. wide; *keel* (12.8) 13.2–17.3 mm.

long, the claws (6.7) 7–11 mm., the blades (6.7) 7–8.5 mm. long, 3.2–3.8 mm. wide; *anthers* (0.65) 0.7–0.9 mm. long; *pod* broadly and plumply oblong-ovoid, -obovoid, or subglobose, 1.5–3.5 (4) cm. long, 1.2–2.5 cm. in diameter, the valve-walls 1.2–2 mm. thick, the septum 0.8–2 cm. wide; *ovules* 38–51, averaging ± 44 .—Collections: 11 (v); representative: *Ferris* 1232 (CAS); *Barneby* 12,811 (CAS, NY, POM, RSA, US), 12,896 (CAS, NY, RSA), 12,978 (CAS, RSA); *Wooton* (from Horse Spring) in 1892 (NMC).

Arid sandy plains, dry stony meadows, gravelly banks, and canyon benches, on granitic and various alluvial soils, mostly in grassland or juniper-piñon forest between 5800 and 7600 feet, descending to the floor of the Rio Grande Valley where associated with *Larrea* at 4900 feet, locally plentiful in scattered stations from the Pecos-Rio Grande Divide in central and southcentral New Mexico west to the north slope of the White Mountains and plains adjacent to the north in eastcentral Arizona.—Map No. 101.—May to July, the fruit ripe in late summer and fall.

ASTRAGALUS CRASSICARPUS var. *CAVUS* (hollow, of the pod), var. nov., legumine inflato, cavo, nec seminibus filamentisque farcto solido, valvulis 0.8–2 mm. tantum crassis insignis, caeterius var. *Paysoni* persimilis.—NEW MEXICO: steep gravelly hillside among junipers, 6450 ft., 3 miles e. of Mayhill, in the Sacramento Mountains, Otero County, May 18, 1953, *Barneby* 11,158.—Holotypus, CAS! isotypi, NY, RSA, US!

The hollow ground-plum, var. *cavus*, has already been mentioned as an unnamed form (cf. *Barneby*, 1956¹, p. 498). It was probably first collected in 1892 by E. O. Wooton in west-central New Mexico, but I have only recently acquired sufficiently ample material to demonstrate the consistency of the fruiting characters over an extensive area lying well to the south of var. *Paysoni*. The var. *cavus* is native to a region where the spring months are extremely dry, but it has retained the early-flowering habit of the other ground-plums and consequently is subjected to most unfavorable conditions at anthesis. As might be expected, flowering specimens are often of dwarf stature, the lower peduncles sometimes appearing subradical, but the stems elongate after the fruit is set and sometimes reach a length of 3 dm. as early as mid-May. The cited collections show great variation in stature which ranges from the tall, robust type-series with very large pods obtained in the mountains during a relatively moist season to the low, tufted, small-fruited plants obtained in the open plains in Torrance County, New Mexico, (*Barneby* 12,811, especially) in the exceptionally dry spring of 1955. Both tall and dwarf plants have been collected in different years along the road between Eagar and Nutrioso in Apache County, Arizona. Apart from variation in size, the pods are alike in their relatively thin-textured valves enclosing a large, inflated cavity. In other respects the plants agree closely with var. *Paysoni*, of which var. *cavus* is probably a direct derivative adapted to a more arid climate.

236d. *ASTRAGALUS CRASSICARPUS* var. *BERLANDIERI*

Similar to var. *crassicus*, distinguished principally by the slender, branching, subterranean caudex and consequently different growth-habit, but often bearing larger flowers and pods; *herbage* green, thinly strigulose and pilosulous with straight, appressed or narrowly ascending hairs up to (0.35) 0.45–0.75 mm. long, the calyx often quite thinly pubescent; *stems* 0.7–3 dm. long, subterranean for 1–15 cm., commonly quite slender; *leaves* (2.5) 5–12 (14) cm. long, with (15) 17–29 oval-elliptic, narrowly elliptic, or sometimes oval-obovate, obtuse, obtuse and mucronulate, or sometimes acute leaflets (3) 5–18 mm. long; *peduncles* 3–8 (11) cm. long; *racemes* 6–14-flowered, the axis 1–4 (5) cm. long in fruit; *pedicels* in fruit 2.8–4.5 mm. long; *calyx* (7.5) 7.9–12.7 mm. long, the tube (5.3) 5.6–9.6 mm. long, (3) 3.6–4.8 (5.2) mm. in diameter, the teeth (2) 2.2–4 mm. long; *petals* lilac or pink-purple; *banner* (18) 18.5–25 (27) mm. long, (6.5) 7–10 (11.2) mm. wide; *wings* (14) 15–23.3 mm. long, the claws (6) 6.4–11.2 mm., the blades (9) 10–13.5 mm. long, 2.1–3.8 mm. wide; *keel* (11.2) 12.2–20.7 mm. long, the claws (6) 6.5–11 mm., the blades (5.8) 6.5–10.2 mm. long, (2.7) 3–4 mm. wide; *anthers* 0.6–0.9 mm. long; *pod* globose or broadly

and plumply oblong-ovoid or -obovoid, 2–4 cm. long, 1.7–2.7 cm. in diameter; ovules 34–50, averaging ± 41 .—Collections: 38 (ii); representative: *Jermy 17* (MO, NY); *Shinners 9757* (OKLA, SMU); *E. J. Palmer 13,267* (MO, WIS), *33,959* (NY); *H. H. York* (from Austin) in *1908* (CAS, NY, TEX); *Lindheimer 744, 745* (NY, TEX).

Brushy hillsides and gravelly flats among oak thickets, sometimes on river bluffs or prairies, in rich loamy or silty soils overlying limestone or cretaceous clays, below 1500 feet, locally plentiful on and near the southeast escarpment of Edwards Plateau and extending rarely out onto the adjacent Coastal Plain but apparently not east of the Brazos River, Kerr and Gillespie to Washington and Victoria Counties, southcentral Texas.—Map. No. 101.—March to May, the fruit ripening from late April through summer.

ASTRAGALUS CRASSICARPUS var. *BERLANDIERI* (Jean Louis Berlandier, d. 1851, pioneer botanist in Texas) Barneby in *Amer. Midl. Nat.* 55: 498. 1956, based on *A. mexicanus* (Mexican, inappropriate since 1824) A. DC., *Mém. Soc. Bot. Genève* 6: 224, Pl. 3. 1833.—The species was described from plants grown in Switzerland “provenant de graines des bords de la rivière Guadelupe envoyés par M. Berlandier.”—Holotypus, cultivated fragments preserved with Heyland's original drawing, G! Berlandier's collection from which the seeds were taken is labeled “circa el rio Guadalupe à Bejar, Avril, 1828, No. 2628.” G, P!—*Tragacantha mexicana* (A. DC.) O. Kze., *Rev. Gen.* 946. 1891. *Geoprumnon mexicanum* (A. DC.) Rydb. ap. Small, *Fl. S.E. U. S.* 1332. 1902.

The loosely forking subterranean caudex of var. *Berlandieri*, suggestive of *A. plattensis* rather than *A. crassicaarpus*, was first described by Jones (*Contrib. West. Bot.* 17: 28. 1930), although he failed to distinguish the two Texan astragali with this type of root. The growth-habit is strikingly different from that of other forms of *A. crassicaarpus*, for the stems issue from the soil singly or in groups of two or three together, not all together in a clump; this is not always easy to recognize in carelessly collected specimens. Other differential characters assigned by Rydberg (1926, p. 162; 1929, p. 460, in clave) to *Geoprumnon mexicanum*, such as “whitish” flowers up to “3 cm. long” are either incorrect—the flowers are always purple and the banner rarely reaches 2.7 cm. in length—or are not diagnostic of a natural entity circumscribed by the habit of growth. In Travis County the flowers of var. *Berlandieri* vary considerably in size, the low extremes falling well within a range of variation established for var. *crassicaarpus*. The relatively small number of ovules in the Berlandier ground-plum has no relation to the size of the ripe fruit.

236e. *ASTRAGALUS CRASSICARPUS* var. *TRICHOCALYX*

Commonly taller and coarser than the preceding varieties, more rarely quite slender and decumbent, except for the calyces and pedicels thinly strigulose-pilousulous with loosely ascending or subappressed hairs up to 0.5–0.9 (1) mm. long, the stems glabrous or nearly so toward the base, the herbage green, or grayish only in youth, the leaflets either glabrous or thinly pubescent above; leaves (5) 7–18 cm. long, with 21–33 elliptic or lance-elliptic and acute or subacute, or sometimes all broadly oval or lance-oblong and obtuse, or (especially in some lower leaves) truncate-emarginate leaflets (4) 7–24 mm. long; peduncles usually erect or incurved-ascending; pedicels 4–7.5 mm. long in fruit; calyx (6.6) 8.3–11 mm. long, the pallid tube (5.2) 6–8.1 mm. long, (2.7) 3.5–5 mm. in diameter, the teeth (1.4) 1.9–3.3 mm. long; banner (16) 17.8–24.5 mm. long, 7.4–10.8 mm. wide; wings (14.2) 16–19 mm. long, the claws 7–9.5 mm., the blades (8.4) 9–11.5 mm. long, 2.4–4 (4.4) mm. wide; keel (12.2) 13.7–17.4 mm. long, the claws (6.5) 7.3–9.4 mm., the blades (6.3) 6.5–8.3 mm. long, 3.2–3.8 mm. wide; pod (only rarely humistrate) broadly oblong-ellipsoid, plumply ovoid, plumply obovoid, or globose, 13.5–2.1 cm. in diameter; ovules 48–77.—Collections: 66 (i); representative: *Pl. Gray. Exsicc.* 1249, 1250; *Cory 55,057* (OKLA, WS), *57,014* (CAS, SMU); *Engelmann 1014* (NY, WIS); *Waterfall 6993* (OKLA, TEX); *Fassett 17,356* (WIS, WS), *17,492* (WIS); an extensive series from Missouri collected by *Steyermark* (MO).

Open rocky woodlands and coming out onto the edge of prairies, pastures, and along roadsides, mostly below 1400 feet, scattered but sometimes locally plentiful, northeastern Texas and eastern Oklahoma, east into western Arkansas, and through Missouri into westcentral Illinois.—Map No. 101.—Late March to July, the fruit ripening in midsummer or later, rarely flowering again in fall.

ASTRAGALUS CRASSICARPUS var. *TRICHOCALYX* (Nutt.) Barneby ex Gl., New Ill. Fl. 2: 241. 1952, based on *A. trichocalyx* (with hairy calyx) Nutt. ex T. & G., Fl. N. Amer. 1: 332. 1838. —“Plains of Arkansas, Nuttall! & Dr. Leavenworth! who also found it in Texas!”—No spm. found (1962) in Nuttall's own herbarium (BM); lectotypus, labeled by Nuttall “*Astragalus *trichocalyx*. Ark.,” NY! isotypi, PH, and labeled “*A. carnosus*. Arkansa.,” G, K!—*Geoprumnon trichocalyx* (Nutt.) Rydb. in Bull. Torr. Club 53: 163. 1926. *Astragalus mexicanus* var. *trichocalyx* (Nutt.) Fern. in Rhodora 39: 317. 1937.

The Ozark ground-plum, var. *trichocalyx*, is ordinarily very distinct because of its coarse ascending stems and its villous-tomentulose calyx and pedicels. The pubescence is fugacious, however, for the calyx is deciduous by circumscissile fission above the disc, and the pedicels become glabrate as they thicken and elongate beneath the ripening fruit. The petals are commonly ochroleucous, but not rarely suffused with pinkish-lilac. Slender forms with decumbent stems (*Waterfall 9365*, OKLA, SMU) are occasionally met with, and in these the fruits are humistrate as in other forms of *A. crassicus*. The pod is ordinarily large, 2.5 cm. long or longer and at least 1.5 cm. in diameter, but it is sometimes no larger than that of var. *crassicus* and is exactly like the commonest type of var. *Berlandieri*. Possibly the fruits of var. *trichocalyx* persist longer on the receptacle than in other forms of the species, but too little material with truly ripe pods has been seen to settle this interesting point.

Although there is no reason to suppose that var. *trichocalyx* and var. *Berlandieri* are more closely related to each other than either is to var. *crassicus*, they have been confused since early times. Gray (1864, p. 193) treated them as synonyms (under *A. mexicanus*), although he mentioned some Texan forms, doubtless referable to genuine var. *Berlandieri*, which seemed “too close” to *A. caryocarpus* (= our var. *crassicus*). Fernald distinguished them as varieties of *A. mexicanus*, but his key characters (1950, p. 906–7) purporting to distinguish *A. mexicanus* from *A. caryocarpus* serve only to distinguish material from the Gray's Manual range. The record of var. *trichocalyx* from Louisiana (Fernald; Rydberg) has not been confirmed by specimens.

237. *ASTRAGALUS* *CYPSODES*

Low, robust, commonly quite coarse, strigulose throughout (except the fruit) with fine, sometimes flattened, stiff, straight, appressed hairs up to 0.25–0.5 (0.7) mm. long, the herbage silvery or greenish-canescens, the leaflets pubescent on both sides, often a little more densely so above than beneath; stems several, stout, commonly purplish, (1.5) 1–3 (3.5) dm. long, ascending and radiating from a pluricipital root-crown at or up to 6 (9) cm. below soil-level, simple or few-branched at base, and often spurred at 1 or more nodes preceding the first peduncle, together forming low, bushy plants, the main axis (unless inhibited by drought) elongating beyond the topmost inflorescence and the fruits thus borne at or below the middle of the stems; stipules membranous or subherbaceous, early becoming pallid and papery, deltoid or deltoid-acuminate, 2–7 (9) mm. long, decurrent around half, or the lowest around nearly the whole stem's circumference, the upper ones spreading or deflexed, their margins sometimes beset with a few minute processes; leaves (4) 6–18 cm. long, with short, stiff petiole and (11) 15–25 (29) elliptic, narrowly ovate-lanceolate, or rhombic-elliptic and obtuse or subacute, or (in some leaves) oblong-obovate and retuse, flat leaflets 5–20 mm. long; peduncles stout, at anthesis erect or stiffly ascending, ultimately weighed down by the heavy fruits, 3.5–10 cm. long, shorter than the leaf; racemes loosely (10) 15–30-flowered, the flowers ascending or spreading in age, the axis (2.5) 3.5–11.5 cm. long in fruit; bracts submembranous, ovate, lanceolate, or triangular-lanceolate, 2.5–6 mm. long; pedicels at anthesis ascending, 1.3–2.3 mm. long, in fruit a little thickened, usually arched outward, (1.6) 2–3.4 mm. long; bracteoles

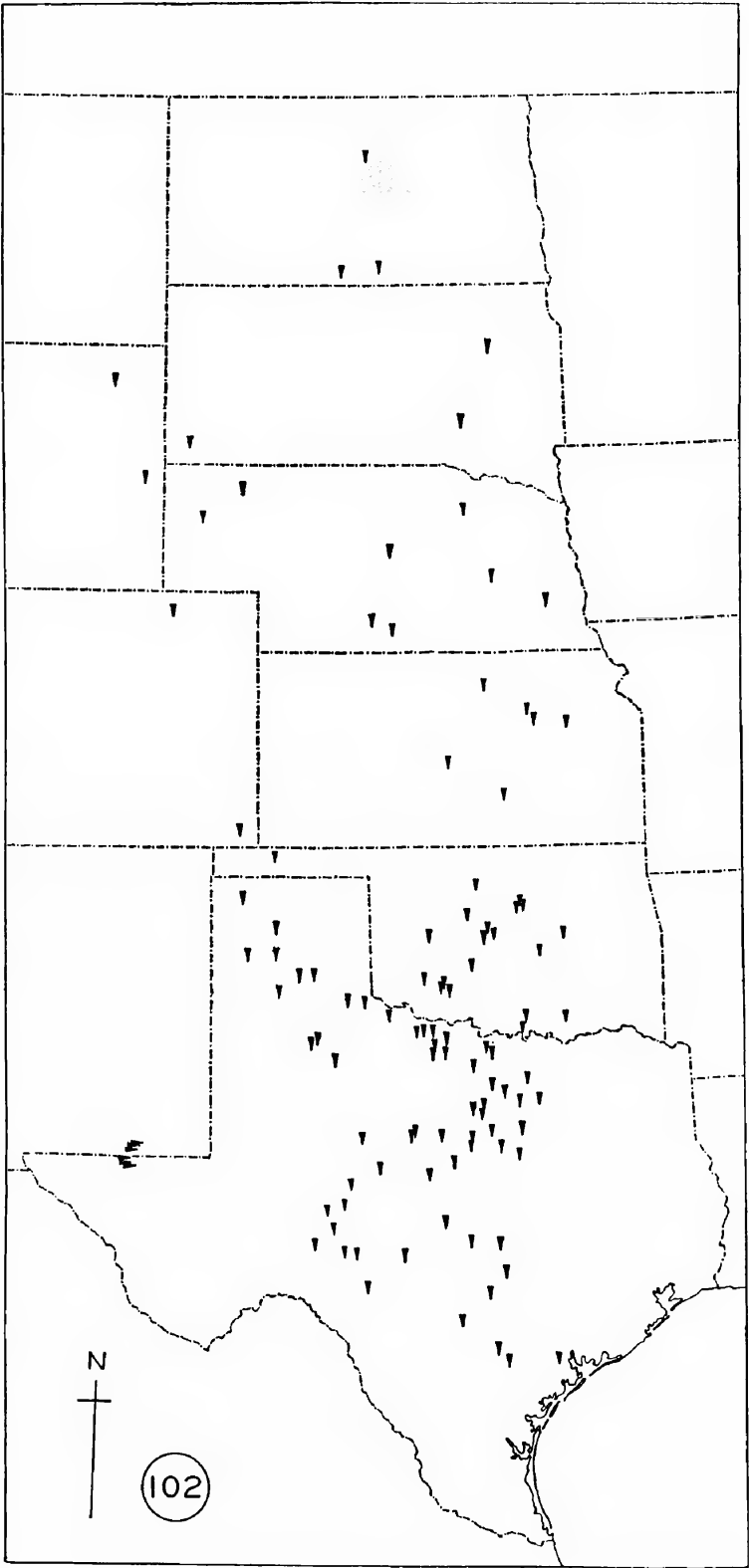
nearly always 2, setaceous or membranous; *calyx* 10.4–14.7 mm. long, finely strigulose with white or largely black hairs, the oblique disc 1.7–2.8 mm. deep, the cylindro-campanulate, purplish or reddish tube 7.3–10 mm. long, 3.8–5 mm. in diameter, the subulate or lanceolate teeth (2.6) 3–5 mm. long, the whole becoming scarious, irregularly ruptured but partially marcescent; *petals* bright pink-purple above the pale claws, drying bluish, the keel-tip deeply maculate; *banner* broadly rhombic-oblongate, 16–23 mm., long, 7.5–12 mm. wide; *wings* 17.6–19.5 mm. long, the claws 8.8–10.4 mm., the lance-oblong, obtuse blades 10.2–11.7 mm. long, 2.4–3.1 mm. wide, slightly incurved in the tapering distal half; *keel* 15.4–18.1 mm. long, the claws 8.9–10.8 mm., the lunately half-obovate blades 7.5–9 mm. long, 3.1–3.5 mm. wide, incurved through 85–90° to the rounded apex; *anthers* 0.7–0.9 mm. long; *pod* loosely ascending or spreading (nearly always humistrate), broadly and plumply oblong-cylindroid, oblong-ellipsoid, or more narrowly cylindro- or clavate-ellipsoid, 2.5–4.5 (5) cm. long, (0.8) 1–2.1 cm. in diameter, straight or rarely a little incurved, subtruncately rounded to broadly turbinate at base, abruptly contracted at apex into a minute, conic-subulate beak, terete or a trifle compressed either laterally, dorsiventrally, or (especially when incurved) shallowly sulcate dorsally at maturity, the extremely thick, succulent, smooth and shining, glabrous, pale green but brightly purple-cheeked valves becoming alveolate-spongy and 1.7–2.3 mm. thick when ripe, the exocarp becoming stramineous or $\pm$ brownish-purple and finely reticulate-wrinkled, the endocarp inflexed as a complete septum nearly as wide as the pod's diameter; *dehiscence* tardy, after falling, primarily basal and upward through the ventral suture, the seeds apparently discharged basally; *ovules* (41) 45–66; *seeds* khaki- or ocher-brown, or soot-black, sparsely pitted or wrinkled, dull, (2.9) 3.2–3.9 mm. long.—Collections: 10 (v); representative: *McVaugh 8106* (DS, G, SMU, TEX); *Warnock 5490* (SRSC); *Ripley & Barneby 10,099* (CAS, RSA), *11,143* (CAS, NY, RSA), *11,152* (CAS, NY, RM, RSA, SMU).

Dry flats, gullied knolls, and low rolling hills, on gypsum or stiff gypseous clay soils, 2600–3900 feet, locally plentiful in the valley of the Black River near Carlsbad Cavern, southern Eddy County, New Mexico, and extreme northern Culberson and adjacent Reeves Counties, Texas.—Map No. 102.—March to May.

ASTRAGALUS GYPSODES (of gypsum) Barneby in Amer. Midl. Nat. 55: 499. 1956.—“New Mexico. Gypsum flats and low gullied gypseous hills, altitude 3650 ft., 7 miles SW of White's City, Eddy Co., 17 May, 1953, *Ripley & Barneby* No. 11138 ...”—Holotypus, CAS! isotypi, GH, K, NY, OKLA, POM, RM, RSA, SMU, US, WS, WTU!

The gypsum milk-vetch is a handsome, coarse plant, a member of a small, distinctive flora confined either to pure gypsum or to soils of high gypseous content. Against a background of whitish clay barrens, the plants with their silvery foliage and abundant purple flowers stand out with equal advantage in early spring as later in the season when the relatively enormous, red-cheeked, juicy fruits have reached their full size. By the middle of June, when tardier gypsophytes, such as *Anulocaulis leiosolenus* (Torr.) Standl. and *Nama carnosum* (Woot. & St.) C. L. Hitchc. are beginning to dominate the scene, the pods of the astragalus are long shed; light as cork after evaporation of their succulent sap, they have been scattered by the wind.

The species is notable among the *Sarcocarpi* for its subcylindrical, commonly sausage-shaped pod which, even though fully as thick-walled as that of *A. crassicaarpus*, tends to fall and dehisce earlier and more readily. It differs further from var. *crassicaarpus* in its looser, more numerous flowered racemes which are held erect at anthesis and only become humistrate when weighed down to the ground by the heavy fruits. A loosely flowered form of var. *crassicaarpus*, local in southeastern Colorado and eastern New Mexico (already mentioned above), is less suggestive of direct passage between the species as of the probable origin of the rare and physiologically specialized *A. gypsodes* by mutation from some antecedent form of the widely dispersed and adaptable *A. crassicaarpus*. The extra pair of chromosomes reported by Head (1957) must, however, isolate *A. gypsodes* genetically from its near kindred.



238 ASTRAGALUS PLATTENSIS

Low, diffuse or decumbent, with an oblique or vertical, often deeply buried (and seldom collected) woody taproot giving rise to slender, branched and often widely creeping, subterranean caudex-branches, these often furnished at the nodes with adventitious rootlets, the stems emerging from the soil singly or few together to form loosely entangled mats or more widely spaced and apparently independent growths, the whole plant (or at least the stems, petioles, peduncles, or some of these) thinly to densely pilose with widely to narrowly ascending or spreading, rarely subappressed, straight or subsinuous, lustrous hairs up to (0.9) 1–1.5 (1.9) mm. long, these often mixed with shorter, curly ones, the herbage green or grayish-green, the leaflets usually less densely pubescent to medially glabrescent or often quite glabrous above; *stems* of the year (excluding the similar but indurated caudex-branches) for a space of 1–20 cm. slender, simple, subterranean, becoming on emergence stouter and bearing 1–several spurs or divaricate branches at the early aerial nodes, simple distally, the main axis above ground (0.5) 1–2.5 (3.7) dm. long; *stipules* dimorphic and variable, 1.5–7 mm. long, those at the lowest leafless nodes the smallest, papery or scarious, either semiamplexicaul or fully so and connate into a bidentate or truncate sheath, the median and upper ones herbaceous, glabrous or glabrescent dorsally, the median commonly broadly ovate- or asymmetrically obcordate-acuminate and broader than the stem, the upper ones narrower, rarely all narrow and lanceolate, embracing half to the whole stem's circumference, the margins either in contact but free, or connate for a short space, the blades ciliate and the margins also bearing a few minute, knob- or tack-shaped processes; *leaves* 2.5–11.5 cm. long, shortly petioled or the uppermost subsessile, with (11) 15–27 broadly to narrowly elliptic, oval, or oblong, obtuse or acute, or in some lower or rarely all leaves oblong-obovate and truncate-emarginate, flat or loosely folded leaflets (2) 4–13 (17) mm. long; *peduncles* ascending, or divaricately humistrate in fruit, (1) 2–7.5 cm. long, shorter than the leaf; *racemes* loosely but shortly, at first often subumbellately (3) 6–15-flowered, the flowers ascending or spreading, the axis little elongating, 0.7–2.5 (3.2) cm. long in fruit; *bracts* submembranous, pallid, greenish, or purplish, lanceolate or ovate-acuminate, (2) 3–7.5 mm. long; *pedicels* at anthesis ascending, straight, 1.4–2.8 mm. long, in fruit thickened, sometimes a little arched outward, 2.4–3.8 mm. long; *bracteoles* commonly 2, sometimes rudimentary or 0; *calyx* 7.8–12.2 (13.7) mm. long, pilose like the herbage or more shortly pilosulous with white or sometimes largely black hairs, the oblique disc 1.1–2 mm. deep, the rather deeply campanulate, basally oblique (or when broad a trifle gibbous), membranous, purplish tube 5.4–7.8 mm. long, 3.2–5 (5.3) mm. in diameter, the subulate or lance-subulate, herbaceous teeth (2) 2.6–4.7 (6.1) mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* pink- or lilac-purple, the color fugacious in drying, the banner sometimes largely pallid, but keel and wings at least purple-tipped; *banner* broadly oblanceolate, oblong- or ovate-cuneate, usually deeply notched, (14.3) 16.5–20 (21.5) mm. long, 6.5–10.2 mm. wide; *wings* (13) 14.5–17 (18.4) mm. long, the claws (5.9) 6.3–8.2 (9) mm., the oblong-oblanceolate or -elliptic, nearly straight blades 8–10.8 mm. long, (2.3) 2.7–3.7 mm. wide, nearly always obliquely notched or undulate-truncate dorsally below the obtuse apex, rarely obtuse and entire; *keel* (11.5) 12–15.5 (16) mm. long, the claws (6) 6.4–8.7 mm., the lunately elliptic blades (6.1) 6.5–8.1 mm. long, (2.8) 3–3.9 mm. wide, rather gently incurved through 80–95° to

the blunt apex; *anthers* 0.5–0.7 (0.75) mm. long; *pod* ascending or spreading (humistrate), sessile, long persisting on but finally disjointing from the receptacle (this sometimes produced as a thick, glabrous, stipelike neck up to 1.3 mm. long), the body obliquely ovoid-oblong, or subglobose, 1–1.7 cm. long, 1–1.3 cm. in diameter, truncate or shallowly cordate at base, abruptly contracted distally into a narrowly conic-subulate, rigid beak 1–3.5 mm. long, a trifle obcompressed, sulcate both dorsally and ventrally, the sutures both thick but embedded in the valves and not salient, the ventral suture nearly straight or at least much less strongly convex than the dorsal one, the thick, fleshy, green but often purple-cheeked or -mottled valves strigulose or pilosulous with appressed or narrowly ascending hairs up to 0.45–0.8 mm. long, becoming brown, stiffly leathery, transversely rugulose and 0.9–1.3 mm. thick at maturity, inflexed as a complete septum 3.6–6 mm. wide; *dehiscence* tardy, through the beak and ultimately through both sutures and the septum, the halves finally falling apart; *ovules* (28) 32–48 (52); *seeds* pinkish-brown turning purplish- or soot-black, smooth but dull, 2.5–3.3 (3.6) mm. long.—Collections: 141 (v); representative: *C. L. Porter* 3547 (NY, RM, SMU, TEX); *Rydberg* 615 (NY); *Cory* 56,269 (OKLA, SMU, WS); *Ripley & Barneby* 7506 (CAS, RSA, UTC); *Cory* 54,050 (OKLA, SMU, WS); *D. Denton* (from Ivan, Texas) in 1931 (NY, SMU, TEX, WS); *Tolstead* 6902 (MO, SMU).

Plains and low rolling hills, commonly on clay-loam or sandy clay prairies, also in abandoned pasture, fallow fields, and gravelly gullies and openings in oak woodland, (100) 500–4550 feet, now most common along fenced rights-of-way, widespread and common southward, becoming rarer northward, Edwards Plateau, southcentral Texas (one old record from the Gulf Coastal Plain near Matagorda Bay) north to eastern Colorado, northeastern Wyoming, and the Souris River in northcentral North Dakota, east to the James River in South Dakota, eastern Nebraska, and the lower Republican River in eastern Kansas; reported (Fernald, 1950, p. 912) from Minnesota, Illinois, and Alabama, the records from the last two states based on *A. tennesseensis*.—Map No. 102.—Late March (southward) to mid-July.

ASTRAGALUS PLATTENSIS (of the Platte River) Nutt. ex T. & G., Fl. N. Amer. 1: 332. 1838 ("Plattensis").—"Plains of the Platte, Nuttall! Dr. James!"—Holotypus, labeled by Nuttall "*Astragalus *plattensis*. Platte Plains," BM! isotypi, GH, NY, PH!—*Tragacantha plattensis* (Nutt.) O. Kze., Rev. Gen. 947. 1891. *Phaca plattensis* (Nutt.) MacM., Metasp. Minn. Vall. 325. 1892, in syn. *Geoprumnon plattense* (Nutt.) Rydb. ap. Small, Fl. S.E. U. S. 1332. 1903.

Astragalus pachycarpus (with thick-textured pod) T. & G., Fl. N. Amer. 1: 332. 1838.—"Prairies of Arkansas, Dr. Leavenworth!"—Holotypus, consisting of 3 ripe, fallen pods, labeled by Torrey "the original specimens," NY! isotypus, K!—*A. crassicaarpus* var. *pachycarpus* (T. & G.) Jones, Contrib. West. Bot. 8: 16. 1898. *Geoprumnon pachycarpum* (T. & G.) Rydb. ap. Small, Fl. S.E. U. S. 1332. 1903.

The range of the Platte River milk-vetch lies within that of its commoner relative *A. crassicaarpus*, and the two species have often been confused. However, with exceptions so rare as to be negligible in practice, the ovary and pod of the common ground-plum are glabrous, whereas those of *A. plattensis* are consistently pubescent. Everywhere, except in southcentral Texas, the growing plants of *A. plattensis* are easily distinguished by their habit alone, for the stems emerge singly or few together from subterranean caudex-branches more slender than the aerial parts. The stems of typical *A. crassicaarpus* arise together in clumps from the knotty root-crown at or barely below the level of the soil and are not noticeably more slender at base than distally. In parts of southcentral Texas *A. plattensis* and *A. crassicaarpus* var. *Berlandieri* are sympatric, and they are so much alike in habit of growth that flowering specimens are best determined by search for hairs on the ovary. The fully formed fruit of the Platte River milk-vetch, even when detached from the parent plant, is by itself diagnostic of the species. Fleshy and thick-walled as in the other ground-plums, it is distinguished by being grooved along both sutures, commonly more deeply so ventrally than dorsally, so that it resembles that of some inflated *Oxytropis* externally, however different in inward structure.

The stipules of *A. plattensis* are astonishingly variable in form and attachment. Plants with stipules at the buried nodes connate into a small, bell-shaped sheath and upper ones amplexicaul and united at base are forcibly reminiscent of some large-flowered *Scytocarp*, being altogether similar in organization and gross aspect up to the eventually (even though tardily) deciduous and fully bilocular, thick-walled pod. On the other hand, the free-stipuled plants, apparently by far the commoner sort, closely resemble *A. crassica* var. *Berlandieri* except in the usually more copious and longer pubescence of the leaves and the grooved pubescent fruit.

The wide distribution east of the Mississippi attributed to *A. plattensis* by Rydberg and Fernald has not been confirmed by specimens. It is based largely on misunderstood records of *A. tennesseensis*, formerly treated as a variety of the Platte River milk-vetch. The species is excluded from the flora of Illinois by Jones & Fuller (Vasc. Pl. Ill. 273. 1956).

The holotypus of *A. pachycarpus*, of which the controversial history has been told elsewhere (Barneby, 1956, p. 500), consists of three ripe pods, remarkable only because they are now hairless, probably glabrate through weathering on the ground. The leafy fragments associated with these fruits are not surely relevant; and if they were so, they would be inconclusive. The fruits are wholly characteristic of the Platte River milk-vetch and cannot be referred to any known species with normally glabrous pod. Dr. Leavenworth's Arkansas was a vague term, including parts of the present Oklahoma, where *A. plattensis* is still one of the commoner astragali. Rydberg's *Geoprimum pachycarpum* (1926, p. 164) is our *A. crassica* var. *Berlandieri* with a small element of var. *cavus*.

LXI (ii). Subsectio SANGUINEI

Flowers very large, scarlet, the nearly erect banner 22.5–31 mm. long; *calyx* circumscissile.—Sp. 1, xerophyte, of Coahuila and Nuevo León.

ASTRAGALUS sect. SARCOCARPI subsect. SANGUINEI, subsect. nov., a *Sarcocarpis* genuinis floribus maximis coccineis, vexillo suberecto absimiles.—Sp. unica: *A. sanguineus* Rydb.

When Rydberg described *A. sanguineus*, the truly ripe fruit was unknown, and it was natural to associate the species with the similarly scarlet-flowered *A. orthanthus* (= our *A. Helleri*) in sect. *Mollissimi*. In reality the pod is not at all in harmony with that of the *Mollissimi*; it is essentially that of *A. (Sarcocarpis) crassica*, of the same succulent, fleshy texture becoming pithy in ripening and dehiscent in the same manner through both sutures and the septum. The irregularly circumscissile calyx is another and quite unusual feature common to *A. sanguineus* and *A. crassica*, but foreign to the *Mollissimi*. It seems fairly certain that *A. sanguineus* is a specialized member of the *Sarcocarpis* comparable but not immediately related to *A. Helleri* and *A. coccineus*, the red-flowered derivatives of sect. *Mollissimi* and sect. *Argophylli* respectively.

239. ASTRAGALUS SANGUINEUS

Perennial from a thick taproot and loosely forking caudex, strigulose with short appressed or subappressed hairs, the herbage greenish, the leaflets usually glabrous above; *stems* prostrate or weakly ascending, 0.5–4.5 dm. long; *stipules* 3–14 mm. long, broadly triangular or the upper ones lance-acuminate, glabrous or nearly so dorsally; *leaves* 7–27 cm. long, shortly petioled, with (17) 23–39 obovate-elliptic, narrowly elliptic, or subrhombic, obtuse and mucronulate, rarely subacute or retuse, flat or loosely folded leaflets 4–20 (28) mm. long; *peduncles* (2) 5–25 cm. long; *racemes* loosely 7–16-flowered, the flowers ascending at first anthesis, spreading in age, the axis somewhat elongating, 2–10 cm. long in fruit; *bracts* lance-acuminate, (3) 4–7 mm. long; *pedicels* ascending, at anthesis 1.5–2.5 mm. long, in fruit stout, straight, 4–6 mm. long; *bracteoles* 2; *calyx* 10.8–12.5 mm. long, the cylindric tube submembranous, reddish, strigulose, dorsally gibbous at base, 7.5–9 mm. long, 3–4 mm. in diameter, the lanceolate teeth about 3–4.5 mm. long, the whole becoming scarious, ruptured and irregularly circumscissile; *petals* scarlet, drying crimson; *banner* suberect, broadly oblanceolate or rhombic-obovate, 22.5–31 mm. long, 9–13 mm. broad; *wings* as long or decidedly shorter, the claws 9.6–12 mm., the lanceolate or narrowly oblong, obtuse, straight blades 10.8–15 mm. long, (2.6) 3.5–5 mm. wide; *keel* 19.2–24 mm. long, the claws 9.6–12 mm., the oblanceolate, slightly incurved blades 10.4–13 mm. long, 3.5–5

mm. wide, rounded at apex; *anthers* 0.85–1 mm. long; *pod* ascending or spreading (humistrate), sessile but abruptly narrowed (when dry) at base into a short, thick, obconic neck, the body ellipsoid, oblong-obovoid, or subglobose, contracted distally into a very short, conic-apiculate beak, not or scarcely compressed, 2–4.5 cm. long, 1.3–2.5 cm. in diameter, low-carinate ventrally by the broad ventral suture (this $\pm$ 0.7–1.5 mm. wide), the fleshy, green or reddish, minutely strigulose valves becoming light and spongy, $\pm$ 1 mm. thick when fully ripe, the exocarp rugulose-reticulate and brownish-stramineous, the cavity filamentous, the septum broad and complete; *seeds* black, pitted, 3–4 mm. long.—Collections: 12 (o); representative: *R. M. Stewart* 1195, 1452 (GH); *Johnston* 8894 (GH); *E. G. Marsh* 1232, 2266 (GH); *C. H. Mueller* 2407 (GH, TEX), 3180 (TEX).

Open hillsides, gravelly stream beds, and washes, 5300–8300 feet, in scrub-oak and thorn-chaparral or pine forest, apparently not uncommon locally, mountains of Coahuila and Sierra Madre Oriental in Nuevo León.—Map No. 100.—April to August.

ASTRAGALUS SANGUINEUS (blood-red) Rydb. in N. Amer. Fl. 24: 443. 1929.—“Type collected near Saltillo [according to the labels in the Sierra Madre 12–14 leagues, or 40 miles, s. of Saltillo], Nuevo León [presumably Coahuila], in 1880, E. Palmer 243 . . .”—Holotypus, US! isotypi, GH, K, NY (fragm.), P, POM!

The bloody milk-vetch, *A. sanguineus*, is one of the most handsome American *Astragali*, which might be visualized as combining the growth-habit and fleshy-walled but somewhat inflated pod of the hollow ground-plum, *A. crassicaarpus* var. *cavus*, with the long, narrow, scarlet flower of *A. (Argophylli) coccineus*. The species has been associated by Rydberg and by me (Barneby, 1956, p. 501) with *A. Helleri*, but it is easily distinguished by its thinly strigulose (not at all tomentose) vesture and by the obtuse (even though almost as long and equally brilliant) petals. The two species were unaccountably confused by Jones, whose description and figure (1923, p. 235, Pl. 60) of *A. orthanthus* (= our *A. Helleri*) are based largely, or the illustration entirely, on parts of Palmer 243, typus of *A. sanguineus*. When the flowers have fallen and the calyx dropped from the maturing pods, the bloody milk-vetch is difficult to distinguish from some forms of *A. crassicaarpus*. The latter is not known, however, to extend south of the Rio Grande and its pod, at least when as large as that of *A. sanguineus*, is truly glabrous.

LXII. Sectio TENNESSEENSES

Robust, caulescent perennials, with superficial or scarcely buried root-crown; *vesture* basifixed, hirsute; *stipules* mostly very large, several-nerved, the lowest either free or connate; *leaves* imparipinnate, with $\pm$ 23–33 leaflets; *flowers* racemose, spreading or declined in age, of moderate size, the banner 14–19 mm. long; *pedicels* thickened, persistent; *calyx-tube* deeply campanulate to cylindric, dorsally gibbous at base; *petals* ochroleucous, regularly graduated, the keel-tip obtuse; *pod* ascending, humistrate, sessile but elevated on a short gynophore, deciduous, oblong- or lance-ellipsoid, a trifle obcompressed, the thickly fleshy valves becoming deeply alveolate-reticulate in ripening, inflexed as a complete septum; *dehiscence* tardy, after falling and weathering, apical and downward through the ventral suture, the soft tissue of the mesocarp ultimately disintegrating and leaving the blackish, papery shell of the endocarp loosely invested by a mesh of coarse exocarpic fibers; *ovules* 26–36.—Sp. 1, local in midwestern United States from northern Illinois to northern Alabama.

ASTRAGALUS sect. TENNESSEENSES, sect. nov. ab affinibus *Sarcocarpis* calyce basi gibbo et praesertim legumine maturo alveolato-reticulato absimiles, praeterea pube longissima hirsuta stipulisque magnis plurinerviis insignes.—Sp. unica: *A. tennesseensis* Gray.

Following a tradition established by Gray when he reduced *A. tennesseensis* to varietal status under *A. plattensis*, subsequent botanists have almost unanimously agreed in associating

the species with the *Sarcocarpi* or some equivalent group. I do not question the assumption that the *Sarcocarpi* and *Tennesseenses* belong in the same general division of the genus, but the Tennessee milk-vetch stands away from the genuine ground-plums in so many striking particulars as to deserve a section of its own. I must agree with Svenson (in Jour. Tenn. Acad. 16: 137, Pl. VI. 1941), who studied it in the field and published the first good figure of the pod, that it is by no means closely related to *A. plattensis*. The long, hirsute vesture and large veiny stipules are the most immediately noticed and most memorable features of *A. tennesseensis*, but the basally pouched calyx (here, curiously enough, not associated with a nodding flower) and the pod provide the important systematic characters. The pod as first formed is not so very unusual for an American astragalus, for it resembles in outline and fleshy texture that of some *Argophylli*, even though completely bilocular, or even that of *A. (Pterophacos) tetrapterus* at the same stage of growth. Just as the pod of the last named only assumes its extraordinary four-keeled and four-sided figure in the process of ripening, so that of *A. tennesseensis* must be followed through from maturity to the delayed dehiscence before its true nature becomes apparent. The alveolate-reticulate surface of the fully ripe pod, as described in these pages, is achieved by inward collapse of the succulent mesocarp onto a mesh of strong anastomizing fibers, the latter forming the walls of the honeycomb structure while the intervening pits correspond with holes in the mesh. The weathered pod, reduced to the hard endocarp loosely enveloped in an open network of these same fibers, might be likened to a chrysalis wrapped in a cocoon of brown lace.

240 ASTRAGALUS TENNESSEENSIS

Low, usually coarse and robust, with a thick taproot and knotty root-crown, hirsute nearly throughout with fine, straight, lustrous, spreading or feebly retrorse, spirally twisted hairs up to 2–3.5 mm. long, the stems densely so and shaggy, the leaflets more thinly so beneath, glabrous above, ciliate, the herbage green; *stems* several or numerous, decumbent and ascending, (0.4) 1–5 dm. long, arising together in well-furnished, leafy clumps from a point at or just below soil-level, simple or spurred at 1–3 nodes preceding the first peduncle; *stipules* mostly very large and conspicuous, pale green, submembranous, becoming papery-scarious in age, several-nerved, 0.5–2 cm. long, the lowest ones often (but not always) amplexicaul and shortly connate, the median ones (or all) asymmetrically ovate-acuminate and broader than the stem but not fully amplexicaul, the uppermost often lance-acuminate, all hirsute-ciliate; *leaves* (6) 8–15 cm. long, shortly petioled or the uppermost subsessile, with (15) 23–33 oblong-elliptic, obtuse, emarginate, or mucronulate-acute, or (in some lower leaves) obovate-obcordate, thin-textured, flat leaflets (4) 6–23 mm. long; *peduncles* incurved-ascending, 5–10 (14) cm. long, mostly shorter than the leaf, becoming stouter and decumbent in fruit; *racemes* rather compactly 9–20-flowered, the flowers at first ascending, becoming horizontal or a trifle declined, the axis little elongating, 2–5 (6) cm. long in fruit; *bracts* resembling the stipules in texture, narrowly to broadly lanceolate, lance-acuminate, or subulate-caudate, 5–12 mm. long, spreading or deflexed in age; *pedicels* ascending, straight or a trifle arched outward, at anthesis slender, 1.5–2.6 mm. long, in fruit thickened, 2–3.5 mm. long; *bracteoles* 0; *calyx* 8.3–15.1 mm. long, thinly hirsute with white or sometimes a few fuscous hairs, the strongly oblique disc 1.2–1.7 mm. deep, the membranous, pallid tube 5.9–11.4 mm. long, 4.2–4.7 mm. in diameter, gibbous-saccate at base behind the pedicel, this inserted laterally at or above the end, the lance-subulate, thinly herbaceous teeth 2.4–4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish or pale cream-color, immaculate, sometimes drying yellow; *banner* oblanceolate, 14–19 mm. long, (5.5) 6.7–8.6 mm. wide, somewhat sigmoidally arched, the claw incurved to conform with the calyx, the blade recurved through 40° or ultimately further; *wings* 13–16 mm. long, the claws 7–8.6 mm., the oblong or oblong-oblanceolate, nearly straight, shallowly 2-lobed or emarginate blades 7.2–9 mm. long, 2.8–3.5 mm. wide; *keel* 11–13.6 mm. long, the claws 6.7–8.1 mm., the broadly triangular-obovate blades 5–6.3 mm. long, 3.2–3.7 mm. wide, abruptly

incurved through 95–100° to the rounded apex; *anthers* 0.6–0.85 (0.9) mm. long; *pod* ascending (nearly always humistrate), sessile on a stout, glabrous gynophore (1) 1.3–2 mm. long, the body oblong or lance-elliptic in profile, nearly straight or gently incurved, 2.5–4 cm. long, 7–13 mm. in diameter, rounded at base, acuminate distally, slightly obcompressed and shallowly sulcate along both sutures, the fleshy, thinly hirsute valves when first formed either green or pink-tinged, somewhat transparent, 2.5–3 mm. thick, in ripening becoming spongy, stramineous, and by collapse of the mesocarp onto a thick, at first immersed reticulate nervation becoming alveolate-rugulose when fully ripe, inflexed as a complete septum 3–4 mm. wide, the funicular flange well developed, 1.7–2.1 mm. wide; *seeds* indigo-green or black, smooth but dull, 2.8–3.1 mm. long.—Collections: 18 (iii); representative: *Gattinger* distrib. *Curtiss* 593 (NY, SMU); *Ripley & Barneby* 11,037 (CAS, NY, RSA, US, WS), 11,039 (CAS, NY, RSA); *E. J. Palmer* 35,493 (NY); *Rollins & al.* 6017 (GH, NY); *Umbach* (from Utica, Illinois) in 1901 (WIS).

Openings in cedar barrens and at the edge of thickets, on limestone pavement or stony calcareous hillsides, locally plentiful at about 750–850 feet, in central Tennessee (Davidson, Rutherford, and Wilson Counties) and adjoining Alabama (Morgan and Lauderdale Counties), also in unrecorded habitats (but sometimes along railroad rights-of-way) along the upper Illinois and Rock Rivers in north-central Illinois (Ogle, LaSalle, and Grundy Counties); reported, probably erroneously, from Iowa and Missouri.—Map No. 103.—April to June, the fruit ripening slowly and often dehiscent only after winter weathering.

ASTRAGALUS TENNESSEENSIS (of Tennessee) Gray ap. Chapman, Fl. S. U. S. 98. 1860 ("*Tennesseensis*").—"Hills near Nashville, Tennessee, *Lesquereux*, and Lagrange, Alabama, *Prof. Hatch*."—Holotypus, *Lesquereux* in 1855, GH! paratypi (Hatch), GH, NY (fragm.)!—*A. plattensis* var. *tennesseensis* (Gray) Gray in Proc. Amer. Acad. 6: 193. 1864. *Geoprumon* *tennesseense* (Gray) Rydb. ap. Small, Fl. S.E. U. S. 1332. 1903.

The Tennessee milk-vetch is a handsome astragalus of strong, leafy growth, easily recognized as the only hirsute species of the genus native to states lying between the Appalachians and the Mississippi River, and well characterized by its pithy, curiously honeycomb-sculptured, thinly long-hairy fruit. The flowers have been described as yellow from dried specimens, but in central Tennessee at least the petals when fresh are ochroleucous or almost white. The species is quite local, but the precise limits of its dispersal and the delimiting factors are not fully understood. In Tennessee and probably in Alabama, it is restricted to the calcareous cedar glades, but its habitat in Illinois has not been reported. The Lagrange in Alabama, where *Prof. Hatch* collected the species a century ago, has not been identified, and the map is incomplete in this respect. *Fernald* (1950, p. 942) reported the Tennessee milk-vetch from southern Illinois, but this was probably a mistake, for all collections associated with credible labels originated from the Illinois and Rock River Valleys in the northcentral part of the state, a situation corroborated by the modern state floras and by *Welsh* (1960, Map 18). The range-extension to "southeastern Iowa . . . and Missouri," given by *Jones* (1923, p. 238), has not been taken up subsequently and is certainly based on error. Granted that the unidentified Alabama station marks at best a small southward extension of the principal cedar glade area, it appears that the dispersal of *A. tennesseensis* is bicentric, and it is even possible that the populations in the two areas are not identical. The flowers in Illinois seem to be smaller than those in Tennessee, but the point requires confirmation from more ample material. A specimen from Ottawa, Illinois (*Bebb* in 1897, NY), distinguished by unusually narrow stipules, is apparently no more than a minor variant already mentioned as such by *Rydberg* (1926, p. 164).

LXIII. Sectio MEGACARPI

Caulescent, rarely subcaulescent perennials; *stems* arising from a superficial root-crown or suffruticulose caudex; *vesture* basifixed, scanty; *stipules* free; *leaves* imparipinnate, with 9–27 leaflets; *racemes* loose, the flowers (usually large)

spreading or ascending; *pedicels* thickened, persistent; *calyx-tube* campanulate or cylindric; *petals* ochroleucous, whitish, or purple, regularly graduated, the banner variably recurved, the keel obtuse; *pod* sessile but elevated on a stipelike gynophore, subterete or strongly dorsiventrally compressed, either bladdery-inflated and unilocular with papery valves, or merely turgid and semibilocular with leathery valves; *dehiscence* apical, through the beak, after falling; *ovules* (18) 26–54.—Spp. 3, xerophytes, of the Great and Columbia Basins, the Colorado Plateau, and the Green River Basin, 1 extending feebly northeast in Wyoming to the upper North Platte, 1 north to the Fraser Valley in southern British Columbia.

ASTRAGALUS sect. MEGACARPI (Rydb.), comb. nov., based on *Phaca* subgen. *Podocystis* sect. *Megacarpae* Rydb. in N. Amer. Fl. 24: 338. 1929.—Sp. typica: *P. megacarpa* Nutt. = *A. megacarpus* (Nutt.) Gray.

Astragalus sect. *Inflati* ser. *Oophori* Jones, Rev. Astrag. 96, in clave. 1923.—Sp. typica: *A. oophorus* Wats.

Phacomene Rydb. in Amer. Jour. Bot. 16: 204, Pl. XVII R. 1929.—Generitypus: *P. Beckwithii* (T. & G.) Rydb. = *A. Beckwithii* T. & G.

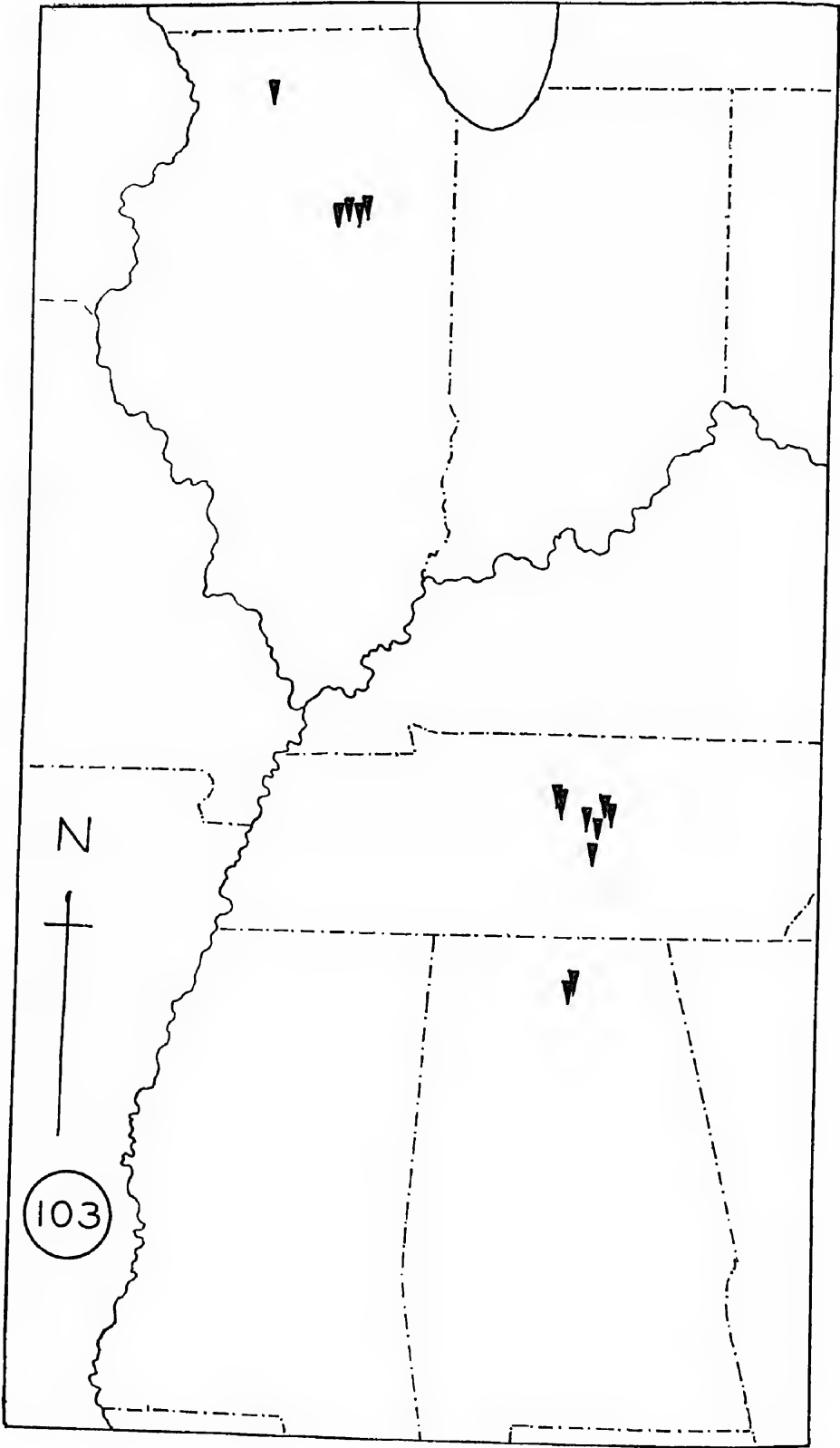
The section *Megacarpis* is characterized by relatively large flowers, leathery foliage, and a large pod elevated on a stipelike gynophore and disjoining when ripe. It consists of three highly modified species which present remarkable diversity in the proportions of the flower and in the form and texture of the pod. At first thought, it would seem impossible to demonstrate any close kinship between the typus of the section, *A. megacarpus*, a subcaulescent plant with long, narrow flowers followed by immense, spindle-shaped, unilocular bladders borne in clusters near the ground, and *A. Beckwithii*, typus of Rydberg's genus *Phacomene*. The latter species is an ordinarily caulescent plant with broader and shorter flowers and a pod dorsiventrally compressed, often strongly incurved, not inflated, and with leathery walls inflexed as a partial septum. The clues to the affinity are provided by *A. oophorus*, of which one variety or another combines a caulescent habit of growth either (var. *lonchocalyx*) with the flower of *A. megacarpus* or (var. *caulescens*) with the flower of *A. Beckwithii* and a pod papery, inflated and unilocular but strongly oblique. Considered collectively, the *Megacarpis* form a compact group interconnected by overlapping characters. The affinities of the section in the genus are far from clear. The flower of *A. megacarpus* resembles in fine detail those of several *Argophylli*, and these two sections may have arisen through processes of divergent evolution from a remote common ancestor. With the possible exception of the isolated *A. lutosus*, no other group characterized by a bladdery fruit bears any close relationship to the *Megacarpis*.

Key to the Species of Sect. Megacarpis

1. Pod 3–6 cm. long, bladdery-inflated, unilocular, the valves papery (if some pods less than 3 cm. long, then the flowers less than 1.5 cm. long) (2)
 2. Plants subcaulescent, the stems 1–5 cm. long, the internodes mostly concealed by stipules and the leaves gathered into a basal tuft; *peduncles* subradical, 0.5–2.5 (7) cm. long; *racemes* 3–5 (8)-flowered; *ovary* and pod strigulose 241. *A. megacarpus*
 2. Plants caulescent, the stems 5–20 cm. long, rarely shorter, and if so then at least one internode developed and at least one leaf, usually many, obviously cauline; *peduncles* from median and upper axils, 4–13 cm. long; *racemes* 4–13-flowered; *ovary* and pod glabrous 242. *A. oophorus*
1. Pod 1.5–3 cm. long, solid or somewhat turgid but never bladdery, the valves fleshy becoming stiffly leathery, nearly always inflexed dorsally as a partial even though narrow, and obscure septum; *banner* at least 16.5 mm. long 243. *A. Beckwithii*

241. ASTRAGALUS MEGACARPUS

Low, robust, subcaulescent or shortly caulescent, commonly appearing glabrous but the leaflets thinly ciliate and strigulose on the midrib beneath with straight, appressed hairs up to 0.25–0.5 (0.6) mm. long, more rarely cinereous, especially when young; *stems* numerous, 1–5 cm. long, arising from scaly caudex-branches at or just below soil-level, simple or spurred at 1–2 nodes below the first peduncle, together forming dense, leafy tufts 1–4 dm. in diameter, the internodes mostly concealed by imbricated stipules, if one or more developed then scarcely over 1 cm. long; *stipules* submembranous becoming papery, usually several-nerved,



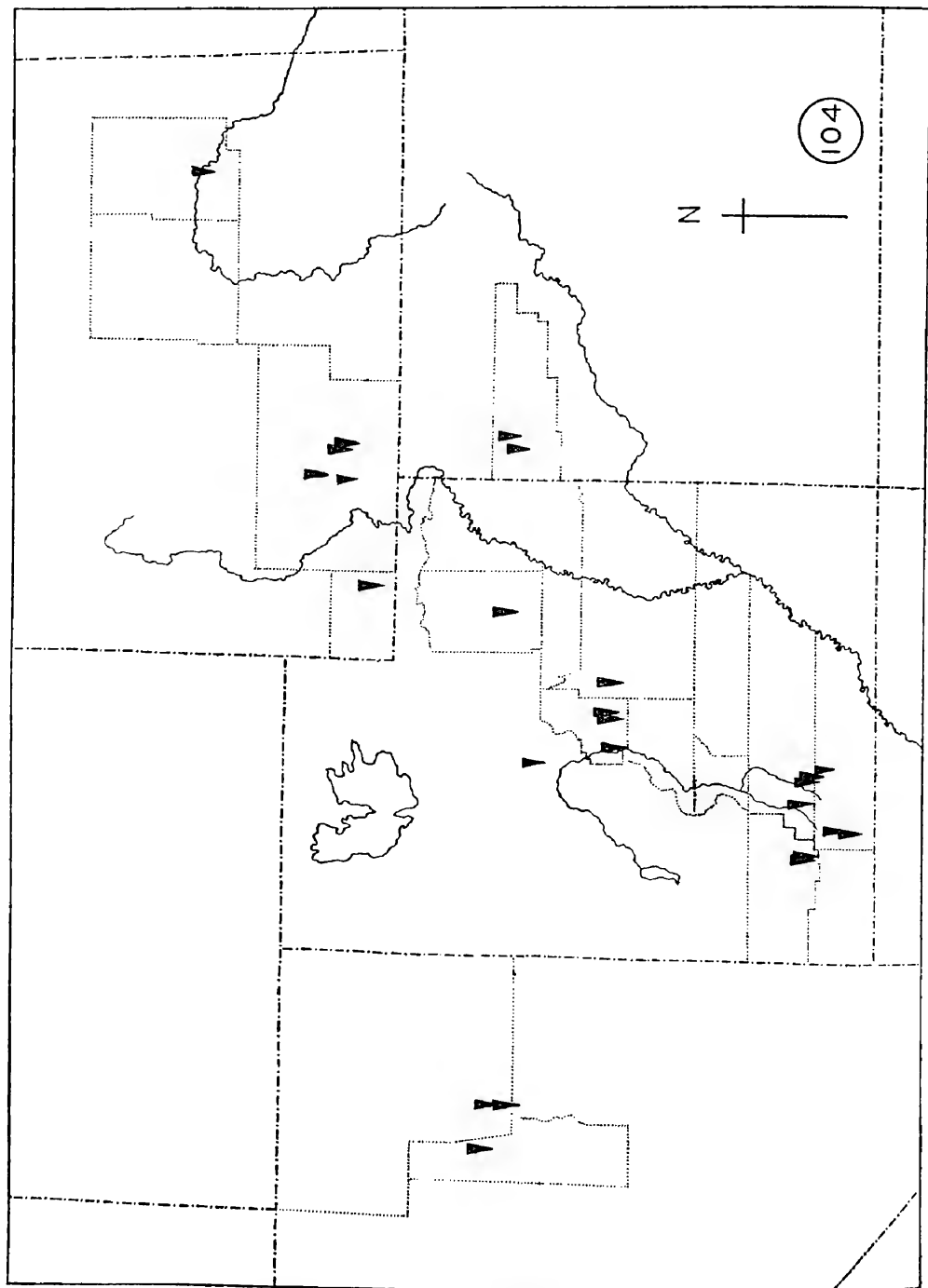
broadly ovate or ovate-acuminate, 3–7 mm. long, amplexicaul-decurrent around the whole stem's circumference but free, forming a loose, pallid, purplish, or castaneous sheath, glabrous or strigulose dorsally, ciliate; *leaves* erect, (2) 5–17 cm. long, with stiff, subpersistent petioles and (7) 9–15 broadly obovate, ovate, oblong-elliptic, or suborbicular, obtuse or shallowly retuse, commonly callous-mucronulate, flat leaflets 5–14 mm. long; *peduncles* 0.5–2.5 (7) cm. long, much shorter than the leaves; *racemes* loosely 3–5 (8)-flowered, the flowers ascending, the axis usually less than 1 (rarely up to 2.5) cm. long in fruit; *bracts* papery-membranous, ovate or ovate-acuminate, 2–5 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 3.5–5 mm., in fruit 5–8 mm. long; *bracteoles* 0–2, attached to the pedicel when present; *calyx* 8.5–13.5 (16) mm. long, strigulose with black or mixed black and white hairs, the strongly oblique disc 1–1.5 (2.5) mm. deep, the cylindric tube 6–10 mm. long, 3–4.3 (5) mm. in diameter, the subulate or lance-subulate teeth 1.9–4.5 (6) mm. long, the ventral sinus cut back and the orifice oblique; *petals* pink-purple, or white with pale pink veins; *banner* gently recurved through $\pm 45^\circ$, oblanceolate or rhombic-oblanceolate, 16.5–22 (26) mm. long, 7.5–11 (12.4) mm. wide; *wings* 14.5–20 (21.5) mm. long, the claws 7–11 mm., the lanceolate, straight or slightly incurved blades 9–11.5 (12.2) mm. long, 2–3 mm. wide below the middle, commonly tapering upward into a narrow but obtuse apex, more rarely oblong and emarginate; *keel* 11.5–17.5 mm. long, the claws 6.5–11 mm., the half-obovate or lunately half-elliptic blades 5.5–7.5 mm. long, 2.5–3.6 mm. wide, incurved through $75\text{--}85$ (90°) to the rounded or sharply deltoid apex; *anthers* 0.7–0.9 mm. long; *Pods* ascending (mostly humistrate), appearing radical, gathered into a ring on the ground beneath the tufted foliage, the gynophore 2–4 mm. long, the body symmetrically or somewhat obliquely ellipsoid or ovoid-ellipsoid, bladdery-inflated, (3.5) 4–6 cm. long, 1.5–2 (or when pressed apparently to 2.5) cm. in diameter, broadly obconic at base, contracted distally into a triangular, laterally compressed, often incurved beak, otherwise subterete or shallowly sulcate ventrally, the papery, thinly strigulose valves at first greenish but commonly either speckled or brightly mottled with reddish-purple, becoming brownish-stramineous and somewhat lustrous, finely reticulate, not inflexed, the funicular flange 0.8–1.4 mm. wide; *ovules* 38–54; *seeds* mahogany-brown turning soot-black, minutely punctate, dull, 2.7–3.4 mm. long.—Collections: 27 (vi); representative: *A. Nelson* 4781 (NY, RM, WS), 7061 (GH, MO, NY, RM); *C. L. Porter* 4509 (NY, RM, SMU, TEX); *Ripley & Barneby* 7780 (CAS, RSA), 9338 (RSA); *Eastwood & Howell* 690 (CAS); *B. F. Harrison* 11,851 (RSA, US); *Holmgren* 820 (NY, UTC, WS).

Gullied hillsides, knolls, and canyon benches, in stiff clays or gravels derived from limestone, shale, or red sandstone, 4900–7600 (10,000) feet, locally plentiful but scattered, the known stations concentrated into four more or less disjunct areas: relatively common in central and southwestern Utah, from the Wasatch Plateau in Emery County south to the headwaters of the Virgin in Kane and Iron Counties; local in the Uinta and Green River Basins, Duchesne County, Utah, Rio Blanco County, Colorado, and Uinta and Sweetwater Counties, Wyoming; apparently isolated on the upper North Platte in Converse County, Wyoming; and on calcareous gravel knolls and hilltops in Eureka and southern Nye Counties, Nevada.—Map No. 104.—Late April to July.

ASTRAGALUS MEGACARPUS (Nutt.) Gray in Proc. Amer. Acad. 6: 215. 1864, based on *Phaca megacarpa* (with large pods) Nutt. ex T. & G., Fl. N. Amer. 1: 343. 1838.—“Plains of the Rocky Mountains, Nuttall.”—Holotypus, labeled by Nuttall “*Phaca *megacarpa*. R. Mts.”

BM! isotypi, GH, NY, PH!—*Tragacantha megacarpa* (Nutt.) O. Kze., Rev. Gen. 946. 1891.

Astragalus megacarpus var. *Parryi* (Charles Christopher Parry, 1823–1890) Gray ex Wats. in Bot. Calif. 1: 148. 1876.—“Southwestern Utah.”—Holotypus, collected, acc. Parry (in Amer. Nat. 9: 204, 270. 1875), near Cedar City, Iron County, in 1874, = *Parry* 51, GH! isotypi, G, K, MO, NY, US!—*A. megacarpus* var. *prodigus* (lavish) Sheld. in Minn. Bot. Stud.



Map No. 104. Utah and parts of adjoining states. Range of *A. megacarpus*.

1: 136. 1894, a superfluous and illegitimate substitute.

Jones (1923, p. 120) has characterized *A. megacarpus* as "very variable," and even if this opinion was colored by misidentified collections of *A. oophorus* var. *caulescens* from Gunnison, Colorado, and from northern Arizona, there is some truth in his statement. The leaflets vary in outline, the flowers vary in size and coloring, and the leaves may be either cinereous or almost hairless. Variation in density of pubescence is partly a seasonal phenomenon, for foliage ashen in early spring may turn green and leathery as summer advances. In the Zion region a variant with leaflets of an elliptic rather than the commoner obovate type is either prevalent or predominant; and this character, combined with supposedly narrower pods, provided the chief differential character of the original var. *Parryi*. However Jones maintained var. *Parryi* (1923, p. 120) principally on account of its purple flowers and assigned it a range extending (if one ignores misplaced elements of var. *caulescens*) from Duchesne County (Theodore) south along the Wasatch to the head of the Sevier and Virgin Rivers. The flowering season of *A. megacarpus* is early and short; consequently the majority of herbarium specimens are in fruit, leaving the question of petal-color open in many instances. So far as I can learn, the flowers are purple in the range indicated by Jones and in the disjunct stations in Nevada; they are white or white with a faint flush of pink or a flare of pink veins in the banner throughout Wyoming and along the White River in northwestern Colorado. A racial division on these lines is possible, but doubts about flower-color in many populations need to be dispelled before the existence of discrete entities can be established.

Whether white or purple, the flowers of the great bladderly milk-vetch appear in late April and May, expanding in clusters near the ground before the leaves are fully developed. The leaves elongate rapidly during and after anthesis and the short subradical peduncles bend out to carry the enormous inflated fruits in a crowded ring, sheltering under and surrounding the central more or less erect, leafy tuft.

242. ASTRAGALUS OOPHORUS

Low, robust or quite slender, caulescent even though shortly so, appearing glabrous, but bearing a few scattered, appressed or narrowly ascending hairs up to 0.35–0.6 mm. long on the leaf-rachis, leaflet-margins, bracts, and sinuses between the calyx-teeth, the herbage dark green or subglaucescent, thick-textured; *stems* several or numerous, decumbent and ascending, (0.25) 1.5–2.5 dm. long, simple or spurred at the lower axils; *stipules* thinly herbaceous becoming papery, (1.5) 2.5–7 mm. long, variably amplexicaul-decurrent, the lowest ones around half to the whole stem's circumference but free, the upper ones around half or less, with deltoid or deltoid-acuminate, spreading or deflexed blades; *leaves* 5–15 cm. long, all petioled, with 9–21 (25) oval, obovate, or suborbicular, obtuse or retuse, but often mucronulate, more rarely (in some upper or even all leaves) elliptic and acute, flat leaflets 4–20 mm. long; *peduncles* ascending or incurved, 4–10 (13) cm. long, mostly shorter than the leaf; *racemes* loosely 4–10 (13)-flowered, the flowers subhorizontal at anthesis, the axis 1–5 (8) cm. long in fruit; *bracts* membranous, or firm but pallid, narrowly ovate or lanceolate, (1.5) 2.5–5 mm. long; *pedicels* at anthesis ascending, 2–4 mm. long, in fruit either straight and ascending or arched outward, (2.5) 3–6 mm. long; *bracteoles* 0–2; *calyx* 6–12 mm. long, glabrous or thinly strigulose with mostly black hairs, the slightly oblique disc 0.6–1.5 mm. deep, the tube either campanulate or cylindric, the subulate or subulate-setaceous teeth 2–5 mm. long, nearly always shorter than the tube, the whole becoming papery, marcescent unruptured; *petals* either purple with white wing-tips or ochroleucous, then sometimes lilac-tinged; *banner* recurved through $\pm 85^\circ$, varying from oblanceolate to rhombic-elliptic or obovate-cuneate, 11–23 mm. long; *wings* as long or commonly a little shorter, 11–21 mm. long, the blades narrowly oblong to lance-oblong, obtuse or subemarginate, mostly straight in the lower half and thence tapering and gently incurved; *keel* 9.5–16 mm. long; *anthers* 0.6–0.8 (0.9) mm. long; *pod* widely spreading or pendulous, or humistrate and then apparently ascending, the slender, straight or decurved gynophore 3.5–12 mm. long, the body ellipsoid or ovoid-ellipsoid, bladderly-inflated,

(2) 3–5.5 cm. long, 1–2 (or when pressed up to 3) cm. in diameter, the papery, glabrous valves at first pale green commonly mottled with reddish-purple, becoming stramineous or brownish and finely reticulate, not inflexed, the funicular flange narrow or almost lacking, 0.2–0.7 mm. wide; *ovules* 28–54; *seeds* brown, dull, finely and regularly punctate, 3–3.7 mm. long.

Key to the Varieties of *A. oophorus*

1. Calyx-tube broadly campanulate, 4–6.5 mm. long, 2–5 mm. in diameter, over half as wide as long; *claws* of the wings and keel 6–9 mm. long; *blades* of the keel half-obovate or -orbicular, abruptly incurved through 90–100° to the blunt, deltoid or obscurely porrect apex; *gynophore* 3.5–8 (10) mm. long (2)
2. Petals bicolored, the banner and keel pink-purple, the wing-tips white; *pod* subsymmetrically ellipsoid, both sutures convexly arched but the ventral one sometimes a little less strongly so than the dorsal one; s. and centr. Nevada, s.-e. California, and reported from s.-e. Oregon (3)
3. Flowers large, the calyx 7–12 mm., the banner 16–23 mm., the keel 11.5–16 mm. long; *ovules* 41–53; widespread, but not of the Charleston Mountains 242a. var. *oophorus*
3. Flowers small, the calyx 6–7 mm., the banner $\pm$ 11 mm., the keel $\pm$ 9.5 mm. long; *ovules* 23–28; Charleston Mountains, Clark County, Nevada 242b. var. *Clokeyanus*
2. Petals ochroleucous, concolorous, the banner rarely tinged with lilac; *pod* strongly asymmetric, half-ovoid or -ellipsoid, the ventral suture straight or a trifle concave, the dorsal one gibbous-convex; e.-centr. Nevada to n. Arizona and w. Colorado 242c. var. *caulescens*
1. Calyx-tube cylindric, 7.8–8.5 mm. long, 3.6–4.4 mm. in diameter, $\pm$ twice longer than wide; *claws* of the wings and keel 10–12 mm. long; *blades* of the keel lunately half-elliptic, gently incurved through $\pm$ 45° to the triangular apex; *gynophore* 10–11 mm. long. Petals bicolored; *pod* subsymmetric; local in s.-e. Nevada and adjoining Utah 242d. var. *lonchocalyx*

242a. *ASTRAGALUS OOPHORUS* var. *OOPHORUS*

Relatively robust and large-flowered; *leaflets* 9–19 (21); *calyx-tube* glabrous, often purplish, (4.6) 5–6.5 mm. long, 3.4–4.5 mm. in diameter, the teeth 2–4.2 mm. long; *banner* broadly oblanceolate or obovate-cuneate, 8–12 mm. wide; *wings* 15–20.5 mm. long, the *claws* 6–9 mm., the *blades* (9) 10.5–13.5 mm. long, 2.7–3.7 mm. wide; *keel-claws* 5.7–8 mm., the *blades* (5.2) 6–8.5 mm. long, 3–4.5 mm. wide *gynophore* 3.5–8 (10) mm. long; *pod* (2.5) 3.5–5.5 cm. long, the broadly obconic beak erect or a trifle oblique, usually not strongly differentiated from the body.—Collections: 32 (iii); representative: *Jones* (from Summit, Owens Valley) in 1897 (CAS, NY, POM, US); *Maguire & Holmgren* 25,249 (NY, RSA, SMU, UTC, WS); *Duran* 2782 (CAS, DS, NY, OB, WIS); *Ripley & Barneby* 6178 (RSA).

Open hillsides and gullied banks, in dry, gravelly or sandy soils derived from various sedimentary and eruptive rocks, commonly with piñon and sagebrush, (5000) 5500–10,200 feet, locally plentiful and rather frequent in the desert ranges from the Panamint Mountains and upper Owens Valley, California, north-east to the upper Walker River and the Toiyabe, Toiyabe, and Monitor ranges in westcentral and central Nevada; reported (as *A. jucundus*, Peck, 1941, p. 446) from southern Malheur County, Oregon, but no specimens found at WILLU.—Map No. 105.—May to July.

ASTRAGALUS OOPHORUS (egg-bearing, of the large pods) Wats., Bot. King 73. 1871.—“Reese River Pass of the Shoshone Mountains, Nevada; 5500 feet altitude; July. [Watson] 278.”—Holotypus, collected in 1868, US! isotypi, GH, NY!—*Tragacantha oophora* (Wats.) O. Kze., Rev. Gen. 947. 1891. *Phaca oophora* (Wats.) Rydb. in N. Amer. Fl. 24: 338. 1929.

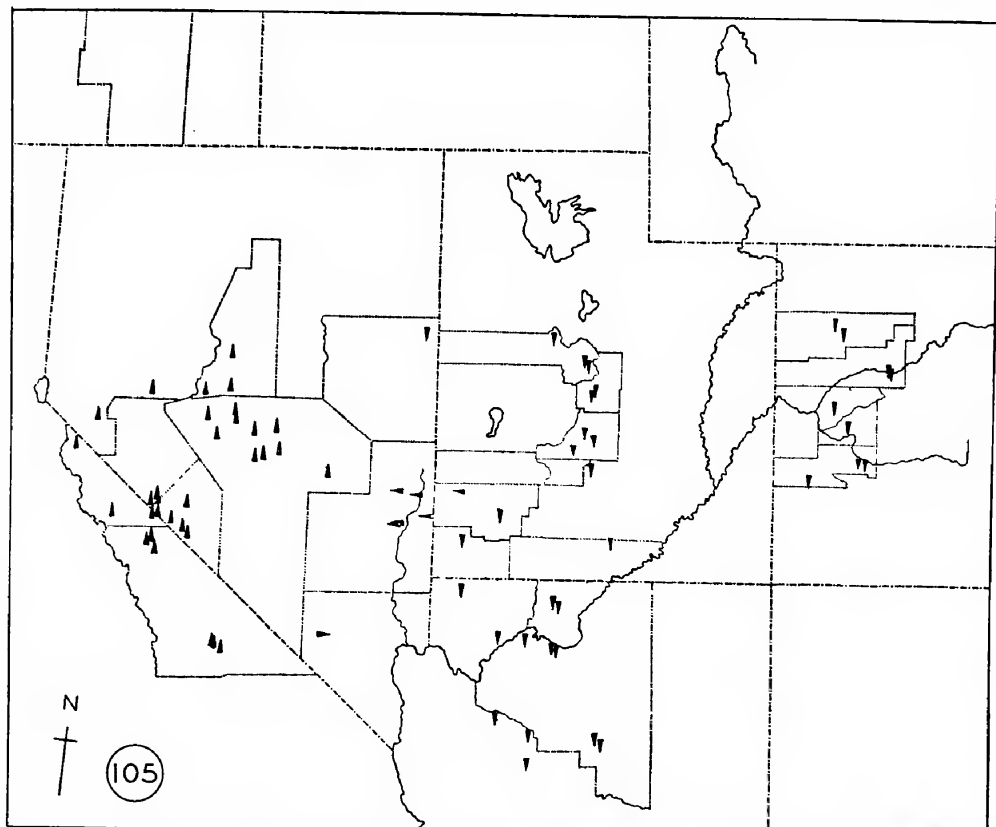
Phaca jucunda (delightful) Jeps. & Rydb. ex Rydb. in N. Amer. Fl. 24: 339. 1929.—“Telescope Peak, Panamint Mountains, California, 1917, W. L. Jepson.”—Holotypus, *Jepson*

7005, JEPS!—*Astragalus jucundus* (Jeps. & Rydb.) Peck, Man. Pl. Ore. 446. 1941, attributed to "Rydb. & Jeps.," evidently based on the preceding.

The typical form of the egg milk-vetch or spindle loco (as Jepson has called it) is well characterized by its parti-colored flowers and large, fusiform, swollen fruits which are ordinarily mottled with red on a pale green ground. It is one of the few astragali characterized by a truly glabrous calyx-tube. Pod and gynophore both vary considerably in length in var. *oophorus*, but the variety is rather uniform in other respects.

242b. *ASTRAGALUS OOPHORUS* var. *CLOKEYANUS*

Low and slender, the stems up to 1 dm. long; *leaflets* small, less than 1 cm. long; *flowers* like those of var. *oophorus* but much smaller, the calyx-tube 4–4.3 mm. long, 2.6–3.3 mm. in diameter, the teeth $\pm$ 2 mm. long; *banner* obovate-



Map No. 105. The Great Basin and Colorado Plateau. Range of *A. oophorus*: $\blacktriangle$ var. *oophorus*; $\blacklozenge$ var. *Clokeyanus*; $\blacksquare$ var. *lonchocalyx*; and $\blacktriangledown$ var. *caulescens*.

cuneate, $\pm$ 5 mm. wide; *wings* as long as the banner, the claws 5 mm., the narrowly oblong blades 7 mm. long, 1.5 mm. wide; *keel-claws* 5 mm., the blades 4.6 mm. long, 2.7 mm. wide; *gynophore* 3.5–5.5 mm. long; *pod* 2–3.7 cm. long.—Collections: 4 (i); representative *LaRivers & Hancock* 513 (NA); *Ripley & Barneby* 4979 (RSA).

Open slopes in yellow pine forest, in gravelly soils derived from limestone, 8100–9100 feet, known only from the east slope of Charleston Peak, Clark County, Nevada.—Map No. 105.—June and July.

ASTRAGALUS OOPHORUS var. *CLOKEYANUS* (Ira Waddell Clokey, 1878–1950, author of a *Flora of the Charleston Mountains*) Barneby in *Leaf. West. Bot.* 7: 194. 1954.—"Lee Canyon

Pipe Line Ridge, Charleston Mts., Clark Co., *Percy Train 2141*."—Holotypus, NA! isotypi, ARIZ, UC!—*A. artipes* sensu Clokey in Madroño 6; 216. 1942, non Gray.

The var. *Clokeyanus* closely resembles the typical form of the egg milk-vetch except for the much smaller flowers and relatively few-ovulate pod. Known only from the upper reaches of Lee Canyon, it is locally plentiful at the lower edge of the forest belt.

242c. *ASTRAGALUS OOPHORUS* var. *LONCHOCALYX*

Similar to var. *oophorus*, but differing in the relatively long and narrow flower, as described in the key; *calyx-tube* glabrous, the teeth 2.5–4 mm. long; *banner* oblanceolate, 20.5–24 mm. long, 7–10.5 mm. wide; *wing-blades* linear-oblong, truncate or subemarginate, 8.7–11.5 mm. long, 2–2.7 mm. wide; *keel-blades* 6.9–7.9 mm. long, 2.6–3.4 mm. wide; *ovules* 34–38.—Collections: 4 (iii); representative: *Ripley & Barneby 3232, 3486* (RSA); *B. F. Harrison 12,241* (NY).

Dry gravelly hillsides and stony flats, associated with and sometimes sheltering under sagebrush, on limestone, 6000–6600 feet, apparently local, known only from the low mountain ranges about the headwaters of the Muddy River, Lincoln County, Nevada, and adjoining Iron County, Utah.—Map No. 105.—May to June.

ASTRAGALUS OOPHORUS var. *LONCHOCALYX* (with long calyx) Barneby in Leaflet. West. Bot. 7: 194. 1954.—"Fay, 3 miles east of Deer Lodge, Lincoln Co., April 24, 1939, *Percy Train 2630*."—Holotypus, NA! isotypi, NY, TEX!

The var. *lonchocalyx* might be described in loose terms as combining the growth-habit of var. *oophorus* with the long, narrow flower of *A. megacarpus*. In other respects, there is no suggestion of transition between the two species; var. *lonchocalyx* is no doubt derived directly from *A. oophorus* through an independent mutation.

242d. *ASTRAGALUS OOPHORUS* var. *CAULESCENS*

Growth-habit of var. *oophorus*; leaflets sometimes more numerous, up to 25 in some leaves; *calyx* pallid, the glabrous or often thinly black-strigulose tube 4.7–6 mm. long, 3.3–5.5 mm. in diameter, the teeth 2.3–6 mm. long; *banner* rhombic-elliptic or -obovate, 17–21 mm. long, 7–9.2 mm. wide; *wings* 16.5–19 mm. long, the claws 7–9 mm., the blades 11–12.5 mm. long, 2.2–3.5 mm. wide; *keel* 12–14 mm. long, the claws 6–8.2 mm., the blades 5.5–7.5 mm. long, 2.8–3.9 mm. wide; *gynophore* 5–9 mm. long; *pod* (2.5) 3–4 cm. long, flattened or openly sulcate ventrally, gibbous-convex dorsally, nearly always contracted distally into a well-defined, $\pm$ incurved, laterally compressed beak, the straight or gently concave ventral suture sometimes produced externally as a narrow longitudinal wing.—Collections: 35 (x); representative: *Jones* (from Silver City, Utah) in 1896 (CAS, NY, POM, WS); *C. F. Baker 169* (ND, NY, POM, WS); *Ripley & Barneby 9164* (CAS, RSA); *Eastwood 7201* (CAS); *McClintock 52-497* (CAS, RSA).

Dry flats and hillsides, in sagebrush, about oak thickets, in piñon or juniper forest, and yellow pine forest, in light gravelly soils overlying sedimentary, granitic, or basaltic bedrock, 4500–8000 feet, widespread and locally plentiful in the mountains surrounding the Colorado Basin, from the Flagstaff and Kaibab Plateaus in northwestern Arizona north to central Utah, and along the White, Grand, and Gunnison Rivers in western Colorado; apparently isolated in eastcentral Nevada (Becky Mountain, White Pine County).—Map No. 105.—May to July.

ASTRAGALUS OOPHORUS var. *CAULESCENS* (Jones) Jones, Rev. Astrag. 121, line 38 (not line 31, where the comb. occurs as a typographical error). 1923, based on *A. megacarpus* var. *caulescens* (with developed stems) Jones in Proc. Calif. Acad. Sci. II, 5: 643. 1895.—"Loa Pass, Utah, 8000' alt., No. 5639f."—Holotypus, collected by Jones on July 17, 1894, POM! isotypus, PH!

Astragalus artipes (with jointed stipe, in reference to the gynophore) Gray in Proc. Amer. Acad. 13: 370. 1878.—"Mokiak Pass, northwest corner of Arizona, Dr. Palmer, 1877."—Holotypus, GH! isotypus, dated "1876," misit Gray, K!—*Phaca artipes* (Gray) Rydb. in Bull. Torr. Club 32: 664. 1905. *A. oophorus* var. *artipes* (Gray) Jones, Rev. Astrag., Index to Plates, publication of the comb. evidently intended on p. 121, line 31 of the text, in place of the first "var. *caulescens*."

The pallid egg milk-vetch, which bears through an accident the inappropriate epithet *caulescens*, has almost everything in common with var. *oophorus* except the ochroleucous petals and strongly asymmetric pod. It is more widely dispersed and more variable than other forms of the species, and perhaps consists of two or three geographic races, although these are not well differentiated. The plants of the Arizona plateaus are, for the most part, of more slender growth and have more numerous (up to 21–25) leaflets than found elsewhere in the range of var. *caulescens*. In Utah, Nevada, and Colorado the lateral leaflets rarely exceed 9 pairs and the calyx is more often black-strigulose. In the southern area the pod is, on the whole, less oblique in profile and has a shorter, sometimes poorly defined beak; moreover, the banner is occasionally suffused with lilac. Plants of this sort, among which must be included the typus of *A. artipes*, suggest transition toward var. *oophorus*. The flower of *A. artipes*, now faded and seemingly yellowish, was described by Gray as "creamy-white tipped with light purple." The species has been sought in the Mokiak Pass region on several occasions, but always in vain; I do not really know the flower-color in genuine *A. artipes*. In the Sevier Valley var. *caulescens* is sympatric with the closely related *A. Beckwithii*, and there is apparently no way of distinguishing the two until the pod has formed.

243. ASTRAGALUS BECKWITHII

Cauliscent but variable in stature, glabrous or nearly so but the leaflets often thinly ciliate, and the bracts, raceme-axis, and inner face or tips of the calyx-teeth beset with a few straight, appressed hairs up to 0.3–0.6 mm. long, those of the inflorescence usually black, the herbage thick-textured, green, pale green, or glaucescent; *stems* decumbent and ascending from the root-crown or shortly forking caudex, 0.2–3.5 (7) dm. long, simple or bearing 1–3 branches or spurs at the lowest axils; *stipules* herbaceous, the lowest becoming papery, 1.5–10 mm. long, the lower ones amplexicaul-decurrent around half to the whole stem's circumference, the upper $\pm$ semiamplexicaul, with deltoid or triangular, often recurving blades; *leaves* (2) 4–15 cm. long, petioled but the upper ones shortly so, with (7) 11–27 suborbicular, broadly oval, obovate, or rhombic-elliptic, obtuse, retuse, or sometimes mucronulate, flat leaflets 3–25 mm. long; *peduncles* erect or incurved-ascending, 3–14 cm. long, shorter than the leaf; *racemes* loosely but shortly 7–16-flowered, the flowers ascending at a wide angle, the axis 1–7 cm. long in fruit; *bracts* membranous or early becoming so, ovate or lanceolate, 1.5–7.5 mm. long; *pedicels* at anthesis slender, ascending, 1–2.5 mm. long, in fruit either ascending or arched outward, 2–3.5 mm. long; *bracteoles* commonly 2, sometimes conspicuous; *calyx* 7–13.5 mm. long, the subsymmetric disc 0.9–1.5 mm. deep, the tube 3.5–6.3 mm. long, (2.9) 3.2–5.2 mm. in diameter, the subulate or lanceolate teeth from half as long to slightly longer, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, or purple with whitish wing-tips, rarely almost white; *banner* abruptly recurved through $\pm 90^\circ$, 16.5–21 mm. long, broadest either above or below the middle, the blade ovate, obovate, or obscurely fiddle-shaped; *wings* 15–20 mm. long, the claws 6.5–9 mm., the oblanceolate or narrowly oblong-elliptic, obtuse or rarely subemarginate, straight or slightly incurved blades 10–13.5 mm. long, 2.6–4 mm. wide; *keel* 11.5–15.5 mm. long, the claws 6.2–8.5 mm., the half-obovate blades 5–7 mm. long, 2.8–3.8 mm. wide, abruptly incurved through $90\text{--}100^\circ$ to the deltoid, sometimes obscurely porrect apex; *anthers* (0.6) 0.65–0.85 mm. long; *pod* ascending, spreading, or somewhat declined, elevated on a stout, straight gynophore 1.5–5 mm. long, obliquely ellipsoid, oblong- or ovoid-ellipsoid, (1.5) 2–3 cm. long, 6–12 mm. in diameter, sharply incurved or bent (mostly at or below the middle)

through 45–135 (180)°, usually acute at both ends, $\pm$ obcompressed and dorsally flattened or sulcate below the laterally compressed, triangular beak, keeled ventrally by the prominent, narrowly but sharply wing-margined suture, the fleshy, glabrous, pale green or glaucescent and often brightly mottled valves becoming stiffly leathery, brownish or stramineous, inflexed as a narrow, sometimes sub-obsolete septum up to 1 (1.5) mm. wide, this usually broadest just below the beak and becoming narrower or disappearing downward; *ovules* (18) 25–41; *seeds* light or dark brown, smooth but dull, 2.3–3.4 mm. long.

Key to the Varieties of *A. Beckwithii*

1. Pod contracted at a point 1.5–5 mm. above the joint with the gynophore into a clavate or narrowly obconic, sometimes stipelike neck, the dorsal face either flattened or shallowly and openly sulcate; range of the species except along the upper Salmon River in e.-centr. Idaho (2)
2. Petals ochroleucous, concolorous; Utah and n.-e. Nevada to s. British Columbia (3)
3. Calyx-teeth 2.5–4 mm. long; *keel* 12–13 mm. long; *leaflets* (13) 17–27, mostly small and retuse; Utah and n.-e. Nevada 243a. var. *Beckwithii*
3. Calyx-teeth mostly 5–7 mm. long (sometimes shorter in s.-e. Washington); *keel* (12.3) 13–15.5 mm. long; *leaflets* (7) 11–17, mostly large and obtuse; s. Idaho n.-w. to s. British Columbia 243c. var. *weiserensis*
2. Petals purple or bicolored, the wings then with pale or white tips, exceptionally (in w. Nevada) all nearly white, but the banner then lilac-tinged at base; Nevada and extreme w. Utah 243b. var. *purpureus*
1. Pod rounded or broadly cuneate at base, the dorsal face deeply sulcate nearly its whole length; along the Salmon River in Lemhi County, Idaho 243d. var. *sulcatus*

243a. *ASTRAGALUS BECKWITHII* var. *BECKWITHII*

Stems usually slender, (0.2) 1–3 dm. long; *stipules* 2–7 mm. long; *herbage* green or pale green; *leaflets* commonly suborbicular or broadly oval, truncate or retuse, rarely ovate or obovate, 3–13 (17) mm. long; *bracts* 2.5–4 mm., bracteoles 0.2 mm. long; *calyx* nearly always black-strigulose, 7.2–8.2 (9) mm. long, the tube 3.5–5.3 mm. long, 3.2–4 mm. in diameter, the teeth 2.5–3.7 mm. long; *pod* (1.5) 2–3 cm. long, 7–12 mm. in diameter, the valves nearly always, though sometimes only faintly, mottled.—Collections: 25 (v); representative: *Jones 1725* (NY, POM, TEX, UTC, WS, WTU); *Eastwood & Howell 9334* (CAS, RSA); *Train 3693* (NA, NY); *Ripley & Barneby 4763* (CAS, RSA).

Dry hillsides and canyon banks, in alkaline, gravelly soils of various origins but preferring limestone, often among sagebrush or bud-sage (*Artemisia arbuscula* or *A. spinescens*), 4200–6450 feet, common and locally abundant in and around the Great Salt Lake Desert in northwestern Utah and northeastern Nevada, south, becoming rarer, to the middle Sevier Valley and Escalante Desert in central and southwestern Utah.—Map No. 106.—Late April to June.

ASTRAGALUS BECKWITHII (Edwin Griffin Beckwith, 1818–1881, Lieut. U. S. A. in command of Gunnison's Expedition after the latter's death in 1853) T. & G. in Pac. R. R. Rep. 2: 120. 1855.—“On the Cedar Mountains, west of Lone Rock, and south of Great Salt Lake...”—Holotypus, collected by Beckwith in 1854, GH!—*Tragacantha Beckwithii* (T. & G.) O. Kze., Rev. Gen. 943. 1891. *Phaca Beckwithii* (T. & G.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906. *Phacomene Beckwithii* (T. & G.) Rydb. in Amer. Jour. Bot. 16: 205. 1929.

The typical variety of the Beckwith milk-vetch is a relatively slender plant with almost round, emarginate or very obtuse leaflets rarely surpassing 12 mm. in length. To the north of Great Salt Lake the plants tend to become coarser in growth, with larger obovate leaflets, and on the Smoke River watershed these probably pass gradually into var. *weiserensis*. It differs perceptibly from var. *purpureus* only in having creamy-white petals without any trace of purple.

243b. *ASTRAGALUS BECKWITHII* var. *PURPUREUS*

Wholly like var. *Beckwithii*, slender and often low, the stems (0.2) 1.5–2.5 dm. long; *stipules* 1.5–6 mm. long; *leaflets* (11) 13–27, oval, orbicular, or obovate, truncate or retuse, 3–12 mm. long, the herbage pale green or commonly glaucescent; *bracts* 1.5–3.5 mm., *bracteoles* 0–1 mm. long; *calyx* very thinly black-strigulose, 7–9.5 mm. long, the tube 4.7–5.7 mm. long, 3.2–4.4 mm. in diameter, the teeth 2–4.3 mm. long; *banner* 17–21 mm., keel 11. 5–14 mm. long; *pod* as in var. *Beckwithii* but usually more brightly mottled.—Collections: 37 (viii); representative: *Clokey* 7989 (CAS, NA, NY, OB, RSA, SMU, TEX, UC, WIS, WS); *Maguire & Holmgren* 25,233 (NY, RSA, UTC, WS), 25,297 (NY, RSA, UTC); *Ripley & Barneby* 3525, 3553 (CAS, RSA); *Eastwood & Howell* 9385 (CAS, WS).

Gravelly flats, hillsides and gullied knolls, with piñons and sagebrush, almost exclusively calciphile, 5900–7300 (8000) feet, locally abundant in the valleys and foothills of eastcentral, central, and southern Nevada, extending east just across the State line into western Juab and Beaver Counties, Utah.—Map No. 106.—May and June.

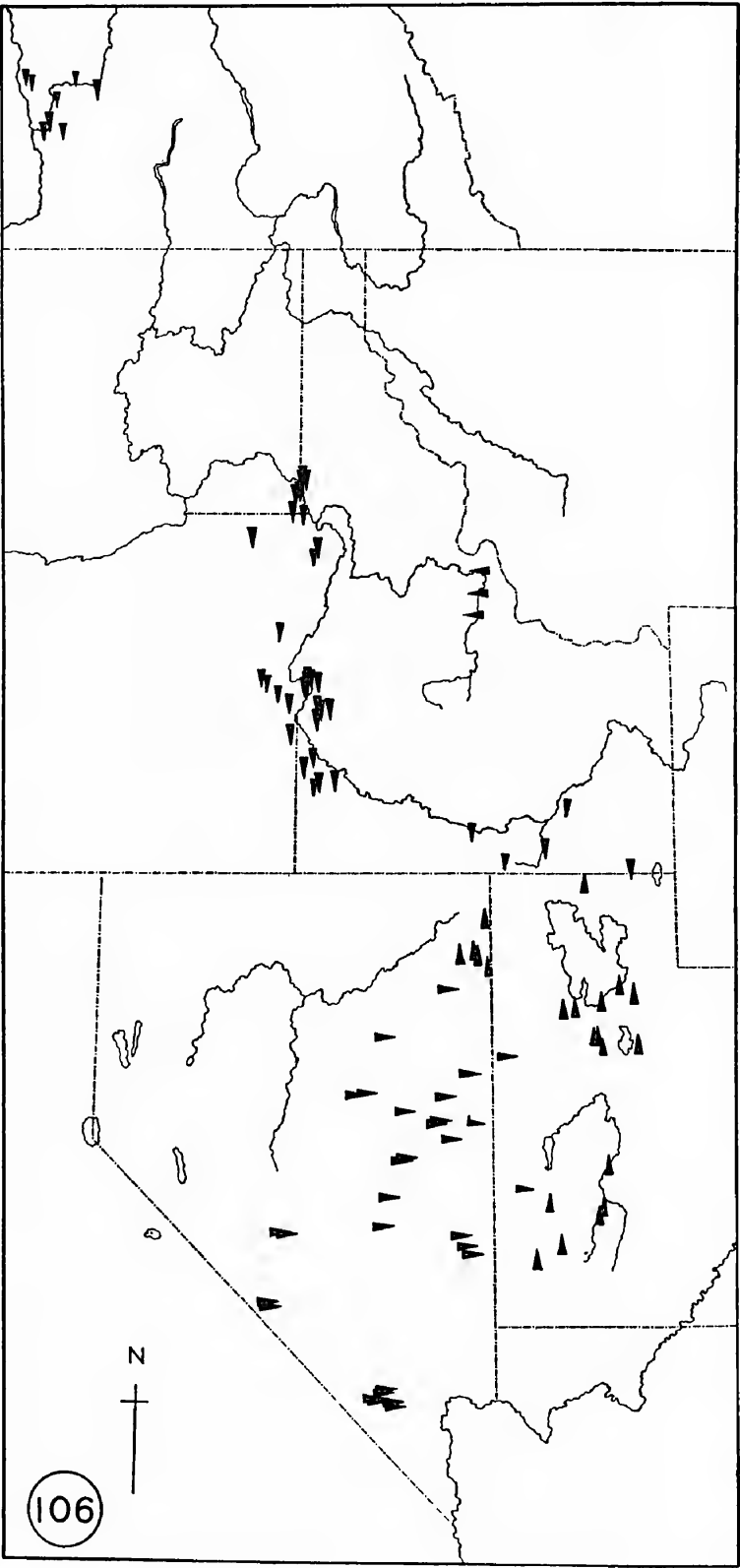
ASTRAGALUS BECKWITHII var. *PURPUREUS* (purple-flowered) Jones in *Zoë* 3: 288. 1893.—“... never has been found east of the Deep Creek Mountains in the western edge of Utah.”—Lectotypus, collected at Aurum, White Pine County, Nevada, Jones in 1893, POM!—*Astragalus artemisiarum* (of sagebrush) Jones in *Zoë* 4: 369. 1894 (“*Artemisiarum*”), based on the preceding. *Phaca artemisiarum* (Jones) Rydb. in Bull. Torr. Club 40: 48. 1913. *Phacomene artemisiarum* (Jones) Rydb. in N. Amer. Fl. 24: 383. 1929.

The flowers of many species of *Astragalus* vary in color from one population to another, but the color-forms are only rarely segregated geographically as in *A. Beckwithii* and its vicariant var. *purpureus*. When Jones raised his variety to the rank of species, he stressed as differential characters not only the purple flower but also a more fleshy pod and more evident joint between the pod and the gynophore. Returning to the subject a few years later (1900, p. 46), he remarked that the pod of *A. artemisiarum* was more brightly mottled, the whole plant less leafy, and the leaflets smaller. However, none of these differences is consistently found in purple-flowered plants, which can be distinguished ultimately only by the coloring of the petals. Over most of its range the flowers of var. *purpureus* are of a vivid purple hue, but in western Nevada, especially in northern Nye and Esmeralda Counties, an albino mutant forms uniform colonies, the loss of anthocyanin being expressed also in the faint or obsolete mottling of the pod. White flowers turn yellowish on drying, and specimens of this variant cannot be distinguished in the herbarium from typical var. *Beckwithii*. In the field, however, the fresh petals (*Ripley & Barneby* 3739, CAS, RSA) are strikingly different from those of var. *Beckwithii*, being clear white faintly lavender-tinted at base of the blades, not cream-colored and concolorous.

A peculiar form of var. *purpureus*, with stiffly erect pedicels up to 6–14 mm. long, variously distorted calyces and only a few fertile flowers, has been collected in the White Pine Mountains (*Ripley & Barneby* 9318). It resembles one plant of an otherwise normal collection of *A. oophorus* from the Paradise Range in Lander County (*Maguire & Holmgren* 25,384, WS). Both seem analogous to the so-called “*grallator*” form of *A. bisulcatus*, more fully discussed under that heading. Plants of var. *purpureus*, which were collected at Indian Springs and southward toward Las Vegas in Clark County, have been reported (Lakin & Hermann in Amer. Jour. Bot. 27: 245. 1940) as containing from 35 up to 950 ppm. of selenium. The sampled populations were associated with *Stanleya*, but *A. Beckwithii* is not confined to selenium-rich soils and ordinarily lacks the characteristic odor of the selenium-converter. A mistake in identity may possibly have occurred, for *A. Preussii*, a consistently seleniferous species of *Astragalus*, is common in Clark County and superficially similar to var. *purpureus*.

243c. *ASTRAGALUS BECKWITHII* var. *WEISERENSIS*

Usually stouter and coarser than var. *Beckwithii*; *stems* (1) 1.5–3.5 (7) dm. long; *stipules* mostly larger, (3) 4–10 mm. long; *leaflets* less numerous, (7) 11–17, broadly ovoid to rhombic-elliptic, (0.6) 1–2.5 cm. long; *bracts* 3–7.5 mm., *bracteoles* (0.4) 1–4 mm. long; *calyx* glabrous except for a few hairs on the margins and inner face of the teeth, (8.5) 10.2–13.5 mm. long, the tube (4.6) 5.1–6.3



mm. long, (3) 4.3–5.2 mm. in diameter, the lance-subulate teeth (3.6) 5–7.1 mm. long; *petals* as in var. *Beckwithii* but slightly larger, the banner (16) 17–20.5 mm., the wings 17–20 mm., the keel (12.4) 13–15.5 mm. long; *pod* similar, but often of very thick, ultimately rigid texture—Collections: 51 (iv); representative: *Cronquist 7804* (NY, RSA); *Hitchcock & Samuel 2505* (CAS, WS); *J. W. & E. M. Thompson 31* (CAS, NY, WTU); *Hitchcock & Muhlick 8392* (CAS, NY, WS, WTU); *Ripley & Barneby 6129* (CAS, RSA).

Gullied bluffs, river terraces, dry hillsides and sagebrush flats, in sandy, gravelly or heavy clay soils, 100–2500 feet, locally plentiful but discontinuous in range; common about the west end of the Snake River Plains in southwestern Idaho and adjoining Oregon, ascending the Snake to the Raft River and to one station in Franklin County, Idaho; apparently absent from the Grand Canyon of the Snake, but again common below the mouth of the Salmon River in the southeast corner of Washington, the north foothills of the Blue and Wallowa Mountains in Oregon, and adjoining Idaho; isolated along the lower Fraser River (Kamloops and vicinity) in southern British Columbia.—Map No. 106.—Mid-April to June.

ASTRAGALUS BECKWITHII var. *WEISERENSIS* (of Weiser, Idaho) Jones in Zoë 5: 47. 1900 ("Weiserensis").—"Weiser, Idaho."—Holotypus, collected by Jones on April 26, 1900, POM (3 sheets); isotypus, GH!—*Phacomene weiserensis* (Jones) Rydb. in N. Amer. Fl. 24: 383. 1929.

Phacomene pontina (of bridges, from Spence's Bridge) Rydb. in N. Amer. Fl. 24: 383. 1929.—"Type collected at Spence's Bridge, British Columbia, May 18, 1875, *Macoun 450* . . ."—Holotypus, consisting of two collections mounted together: Spence's Bridge, *Macoun*, May 18, 1875; Valley of Fraser River, May 13, 1875, *Macoun 450*, GH!

As compared with var. *Beckwithii*, the individuality of var. *weiserensis* arises from the greater extreme and average dimensions of the flowers and leaflets, from the usually coarser habit of growth, and from the nearly always larger stipules, bracts, and bracteoles. Long calyx-teeth are apparently diagnostic of the variety except in a small area in Asotin County, Washington. These exceptions, which are furthermore somewhat small-flowered, have the few, large leaflets of var. *weiserensis* and are certainly no more than minor variants of the common large-flowered type prevalent around Lewiston and in the Wallowa foothills immediately to the north and south. The typus of the Weiser milk-vetch was derived from a population of exceptionally stout and vigorous plants found on hot, grassy hillsides above the town of Weiser. These are characterized by exceptionally broad and toughly coriaceous pods, but they cannot be distinguished usefully from the form more usual in southwestern Idaho, in which the fruit is essentially like that of typical *A. Beckwithii*. Rydberg stressed a broad, firm pod with broad septum as the diagnostic feature of *Phacomene weiserensis*, but it does not coincide with a biological reality. The disjunct populations on the Fraser River have once again flowers slightly smaller than the form common in Idaho, but are otherwise indistinguishable. I find no difference in the pod whatsoever. The Weiser milk-vetch was collected first in 1830 by David Douglas (K, in bud only).

243d. *ASTRAGALUS BECKWITHII* var. *SULCATUS*

Similar to var. *weiserensis*; *stems* (2) 3–4 dm. long; *stipules* 3–8 mm. long; *leaflets* broadly rhombic- or oblong-ovate, obtuse or mucronulate, 0.7–2.4 cm. long; *bracts* 2–4 mm., *bracteoles* up to 2 mm. long, sometimes 0; *calyx* nearly glabrous except for a few black hairs on and within the teeth, 10.8–12.8 mm. long, the tube 6.2–6.8 mm. long, $\pm$ 5 mm. in diameter, the teeth 4–6.6 mm. long; *petals* cream-colored, the banner 18–20 mm., the wings 18.6–19 mm., the keel 14.5–14.8 mm. long; *pod* elevated on a slender gynophore 4–5 mm. long, the body lunately oblong, incurved through $\frac{1}{4}$ – $\frac{1}{2}$ -circle, 2–2.5 cm. long, 6–7.5 mm. in diameter, the dorsal face sulcate from base to beak, the valves mottled.—Col-

Map No. 106. Idaho, Nevada, and parts of adjacent states. Range of *A. Beckwithii*: ♀ var. *Beckwithii*; ♂ var. *purpureus*; ♂ var. *weiserensis*; and ♀ var. *sulcatus*.

lections: 4 (i); representative: *Payson & Payson 1760* (CAS); *Preece & Turner 2359* (SMU); *Christ 12,242* (NY).

Open brushy slopes, on volcanic gravelly clay soils, 3600–4500 feet, locally plentiful but known only from the banks of the Salmon River in eastern Lemhi County, Idaho, from North Fork upstream about 40 miles.—Map No. 106.—May to July.

ASTRAGALUS BECKWITHII var. *SULCATUS* (grooved, of the pod), var. nov., legumine in gynophoram graciliorem abrupte contracto nec per collum obconicum sensim attenuato, dorso angustius profundiusque sulcato insignis, caeterius var. *weiserensi* Jones praesimilis.—IDAHO: mouth of Warm Spring Creek, Salmon River canyon, 19 miles s. of Salmon, Lemhi County, June 19, 1947, *Ripley & Barneby 8845*. Holotypus, RSA; isotypus UTC.

The valley of the upper Salmon River, as it flows northward through Custer and Lemhi Counties from Clayton to the westerly bend at North Fork, is of particular interest to the botanical geographer on account of locally endemic plant species (including in our genus *A. amblytropis* and *A. aquilonius*), not to mention the presence of several forms of which the main range lies well to the south in the Great Basin. These southern elements may have reached the valley during a recent xerothermic period when a more southern flora was able to spread northward across the low Salmon-Lost River watershed. Subsequent isolation, which followed a change in climate, may have enabled some of these, in the presence of a richly varied choice of soils and rock formations and newly emerging habitats created by rapid erosion of the valley floor, to evolve in new directions. The disjunct occurrence of var. *weiserensis* in British Columbia, which follows an established pattern of plant distribution in the region, shows that *A. Beckwithii* was more widely dispersed northward than at the present time, and it is reasonable to suppose that var. *sulcatus* represents the modified progeny of a relict population dating from the same diaspora.

It has been pointed out above that var. *Beckwithii* and *A. oophorus* var. *caulescens* are virtually indistinguishable until the fruit has formed; the same can be said of *A. Beckwithii* var. *weiserensis* and var. *sulcatus*. These are only two instances of mutations that find external expression in the pod alone. It is small wonder that a system of classification based on the astragalus pod, without reference to other features of the plant-body, can only be partly realistic and is, in practice, often unnatural.

LXIV. Sectio LUTOSI

Diffuse, caulescent, perennial, with subterranean root-crown or caudex; *vesture* basifixed; *stipules* broad, often fully amplexicaul but free or nearly so; *leaves* imparipinnate, with 15–27 crowded, thick-textured leaflets; *flowers* shortly and loosely racemose, ascending, the banner 9–17 mm. long; *calyx-tube* deeply campanulate; *petals* whitish, the banner recurved through $\pm 45^\circ$, the faintly maculate keel-tip obtuse; *pod* ascending (humistrate), sessile but elevated on a stipelike gynophore, the body subsymmetrically ovoid-ellipsoid, bladdery-inflated, unilocular, the valves papery; *ovules* 24–30.—Sp. 1, xerophyte, of shale barrens about the east end of the Uinta Basin near the Utah-Colorado boundary.

ASTRAGALUS sect. *LUTOSI* (Rydb.), comb. nov., based on *Phaca* subgen. *Chartocystis* sect. *Lutosae* Rydb. in N. Amer. Fl. 24: 349. 1929.—Sp. typica (unica): *P. lutosa* (Jones) Rydb. = *A. lutosus* Jones.

The typus of sect. *Lutosi* is a distinguished monotype presumably derived from the same stock as the *Inflati*, *Megacarpi*, and *Argophylli*, but differing from all members of these groups in the subterranean points of renewal. Jones at first described it as "certainly related" to *A. aboriginum* and *A. Hookerianus* (= our *A. Whitneyi*), but he made no distinction between the genuine stipe of these species and the gynophore of *A. lutosus*. The large lower stipules are reminiscent of *A. aboriginum*, but *A. lutosus* has nothing else in common with sect. *Hemiphragmium*. Jones later (1923, p. 119, Pl. 20) associated *A. lutosus* with our *Megacarpi* in his sect. *Inflati*, and I agree that these are probably its nearest known relatives. The pod is technically similar to that of *A. megacarpus*, but the buried root-crown, enlarged stipules, and the many imbricated and conduplicate leaflets form, together with white flowers and a bladdery pod, a combination of features unique in *Astragalus*. The only species was placed by Rydberg

(1929, p. 349) in a monotypic section of *Phaca* subordinated to subgen. *Chartocystis*, curiously distant from other stipitate and gynophorous *Inflati*, for which his subgen. *Podocystis* was designed.

244. ASTRAGALUS LUTOSUS

Dwarf, diffuse, loosely tufted, with a stout, woody taproot, densely strigose-pilous with loosely appressed or ascending, mostly sinuous or incumbent hairs up to 0.3–0.7 mm. long, the herbage cinereous, the leaflets glabrous or medially glabrescent above; *stems* (1) 3–10 cm. long, simple, arising directly from the root-crown or from a forking caudex, pallid, glabrous, and subterranean for a space of (0.5) 2–7 cm., the short aerial tips radiating and prostrate, densely leafy, flexuous or zigzag, together forming loosely woven mats 5–15 (20) cm. in diameter; *stipules* 2–5 mm. long, those at the lower exposed and at the buried nodes, sometimes all, broadly ovate or half-circular, very obtuse, papery, the uppermost deltoid-ovate or triangular, subherbaceous, often purple-tinged, all several-nerved and glabrous or nearly so dorsally, shortly adnate to the petiole-base and amplexicaul-decurrent, the contrapetiolar margins commonly contiguous but not or only very shortly and obscurely connate; *leaves* 1.5–5.5 cm. long, all petioled, with (9) 15–27 crowded or imbricated, obovate, oblong-obovate, or broadly elliptic, obtuse or retuse, thick-textured leaflets 1.5–9 mm. long, diminishing upward along the rachis; *peduncles* 0.5–2 cm. long, ascending at anthesis, reclinate in fruit; *bracts* membranous, or early becoming so, ovate or lance-acuminate, 1.5–2.5 mm. long; *pedicels* ascending, at anthesis slender, 1.2–1.5 mm., in fruit somewhat thickened, 2–3 mm. long, persistent; *bracteoles* 0; *calyx* 4.8–10.4 mm. long, loosely strigulose with white, black, or mixed black and white hairs, the oblique disc 0.5–1.2 mm. deep, the pink tube 3.6–7.4 mm. long, 2.1–3.4 mm. in diameter, the subulate or lance-subulate teeth 1.2–3 mm. long, the whole becoming papery, marcescent; *petals* white, the banner and wings sometimes pink-veined, the keel lilac-tipped; *banner* ovate-cuneate, 9–17 mm. long, 5.8–9 mm. wide; *wings* 9.1–15.5 mm. long, the claws 3.9–8.1 mm., the oblong or oblanceolate, obliquely emarginate, straight or slightly incurved blades 5.8–8.4 mm. long, 2–2.5 mm. wide; *keel* 7.4–13.2 mm. long, the claws 3.7–8.1 mm., the half-obovate blades 4.1–6 mm. long, 2.2–2.9 mm. wide, incurved through $\pm 100^\circ$ to the bluntly deltoid apex; *anthers* 0.55–0.6 mm. long; *pod* loosely spreading or ascending (humistrate), sessile on a stout, purplish gynophore 1–4.5 mm. long, the body subsymmetrically ovoid or ellipsoid, bladdery-inflated, 1.5–3.7 cm. long, 8–15 (17) mm. in diameter, rounded or cuneate at base, contracted distally into a short, compressed-conic beak, a trifle obcompressed near the middle, openly and shallowly sulcate ventrally, rounded dorsally, the thin, pale green but red-checked valves becoming papery, delicately reticulate, strigulose with white or sometimes a few black hairs, not inflexed, the funicular flange 0.5–1 mm. wide; *dehiscence* apical and ultimately through the base and the length of the ventral suture, after falling; *seeds* reddish- or other-brown, smooth but dull, 2.3–3.5 mm. long.—Collections: 5 (ii); representative: *W. A. Weber* 3349 (CAS, DS, RSA, TEX, UTC, WS); *Ripley & Barneby* 9176 (CAS, GH, NY, RM, RSA, UTC).

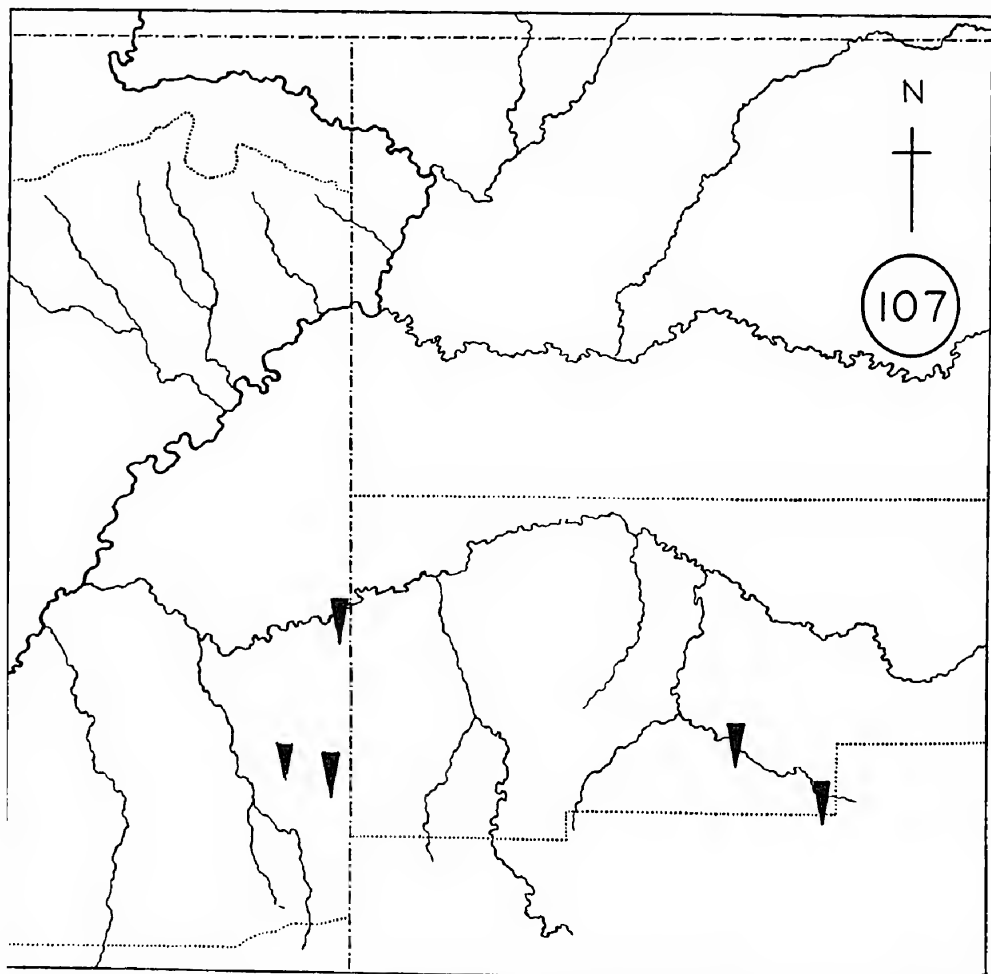
Forming colonies on summits and ridges of white shale knolls and bluffs almost bare of other plants, 5200–6950 feet, rare and local, known only from the White River and affluent creeks around the east end of the Uinta Basin, in Uintah County, Utah (White River; Rainbow; Dragon) and Rio Blanco County, Colorado (Piceance Creek).—Map No. 107.—May and June.

ASTRAGALUS LUTOSUS (muddy, of the soft white shales of the Uinta Basin) Jones, Contrib. West. Bot. 13: 7. 1910.—“White River Utah next the Colorado line, 5200° alt., May 25,

1908... Dragon Utah..."—Cotyti, collected the same day, one at White River, the other near Dragon, both in Uintah County, Utah, POM! isotypi, DS, GH, NY!

The Dragon milk-vetch is one of our rarest species, adapted and apparently confined to an extremely arid environment which is hostile to almost all other plant life. Jones describes (1923, p. 119) the habitat in Utah as being in the poorest white shale on bare places at the foot of cliffs, a fair description of the white knolls and gullied ridge tops on which *A. lutosus* is found along Piceance Creek in Colorado. The species seems to be variable, but I know of it in too few stations to assess the significance of the variation. The Colorado material has much smaller flowers, also a smaller and perhaps thinner-textured pod borne on a shorter gynophore than Jones's original gatherings in Utah.

There has been much confusion about the type-locality of the Dragon milk-vetch, and the original data are already difficult to interpret. The description of the species opens with the words "White River, Utah, next the Colorado line." A description follows terminating with the phrases: "the above is from the material got at Dragon, Utah. The specimens got in the type-locality . . .," this leading on into a second description. In his Revision Jones modified the locality to read: "on the White River, western Colorado, north of Dragon"; and Rydberg (1929, l.c.) gave another version: "White River, near Dragon, Utah, near the Colorado line." Subsequently Jones insisted that his collections came from Colorado, for he criticized Tidestrom severely (cf. Contrib. West. Bot. 15: 21. 1929) for including *A. lutosus* in the Flora of Utah and Nevada. It seems probable, nevertheless, that Jones was indeed in Utah when the astragalus was collected. According to the itinerary worked out by Munz (POM, library), Jones was at



Map 107. Northwestern corner of Colorado and adjacent Utah. Range of *A. lutosus*.

Chepeta Well on the Colorado (Green) River on May 22–23, reached White River (just west of the Colorado line) on the 24th, turned south to Dragon on the 25th, and thence proceeded south-southeast, through Atchee and Carbonero, apparently following the old railroad, to reach Mack, Colorado, on the 27th. Clearly Jones made two collections of *A. lutosus*; and although both labels give the elevation as 6000 feet (in contradiction of the published altitude of 5200 feet), probably only the Dragon material is from the higher station, for it is at an earlier stage of growth. Search in the type-region has not yet turned up a plant quite similar in flower-size to those found by Jones. The one modern collection from Utah (*Barneby 14,160*, CAS, NY, RSA, from southwest of Rainbow, i.e., ± 8 miles airline from Dragon) is unfortunately sterile except for one flower about 12.5 mm. long.

LXV. Sectio PTEROCARPI

Caulescent, sparsely leafy and sometimes subjunceous perennials, with subterranean or almost superficial root-crown; *vesture* basifixed; *stipules* $\pm$ dimorphic, the lowest ones amplexicaul but free, the upper ones narrower, cauline; *leaflets* 3–21, either jointed or decurrent; *flowers* loosely racemose, ascending at anthesis, the banner mostly 13.5–19 mm. long; *pedicels* persistent; *calyx-tube* cylindric or subcylindric, often narrowed at base; *petals* purple or pinkish, rarely white, the wing-tips often paler than the banner, the banner recurved through $\pm 45^\circ$, the keel-tip obtuse; *pod* deflexed, sessile, readily disjoining from the slightly elevated receptacle, large (2–5.5 cm. long), solid or nearly so, slightly to strongly obcompressed, in one species becoming laterally wing-margined and in another sharply tetragonal when ripe, the fleshy valves becoming stiffly papery or leathery, not inflexed.—Spp. 3, xerophytes, of Nevada, extending a short way into the adjoining states.

ASTRAGALUS sect. PTEROCARPI Wats., Bot. King, Append. 439. 1871.—Sp. typica: *A. pterocarpus* Wats.—*Astragalus* sect. *Scuticarpus* Sheld. in Minn. Bot. Stud. 1: 150. 1894, a superfluous substitute.

Pterophacos Rydb., Fl. Rocky Mts. 507, 1063. 1917.—Generitypus: *P. tetrapterus* (Gray) Rydb. = *A. tetrapterus* Gray.—*Astragalus* subgen. *Pterophacos* (Rydb.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 321. 1925.

The least highly modified of the three singular desert species of *Astragalus* that go to form our sect. *Pterocarpus* is *A. Casei*. Its leaflets are all jointed to the rachis and, moreover, its pod is unwinged; and since it closely resembles structurally that of several members of sect. *Argophylli*, it was inevitable that Rydberg should refer the species to his equivalent genus *Xylophacos*. No better example could be furnished of the failure of a taxonomic system based on rigidly preconceived principles, for *A. Casei* is certainly out of place among the genuine *Argophylli* from which it differs in subterranean root-crown, slender, wiry, divaricately branching stems, and loosely racemose, deflexed fruits. Jones showed a refined perception of true relationships when he associated *A. Casei* with *A. pterocarpus* in which xerophytic modification has been carried several steps further, the leaflets being reduced in number and decurrent on the rachis. The pod of *A. pterocarpus* is formed after the same basic design as that of *A. Casei*, but it has become very strongly obcompressed into the shape of a shield, the margins of which dry out in ripening into the remarkable wings emphasized by the specific epithet. The third species, *A. tetrapterus*, is variable in foliage, the lateral leaflets being either articulate or decurrent, and either flat and membranous or narrow, involute, and then commonly also reduced in size. The fruit, when first fully formed, is quite similar to that of some *Argophylli*; it is only when fully ripe that it assumes, through collapse of the succulent walls, the sharply tetragonal figure that is without match or precedent in the genus.

The affinities of sect. *Pterocarpus* are not readily apparent. The group may represent an independent line of modification stemming with the *Argophylli*, *Megacarpus*, and *Sarcocarpus* from a distant common precursor, for all have similarly proportioned flowers and most of them deciduous, more or less fleshy fruits. While some subgroups of sect. *Argophylli* are still in active process of differentiation, the *Pterocarpus* seem to have reached a stationary, probably terminal stage of evolution. Jones evidently perceived the section as a natural group, but he referred it to an unreasonably heterogeneous sect. *Podosclerocarpus*, some genuine members of which are superficially similar in habit of growth, but differ importantly in the stipitate and emmenoloboid pods laterally and not dorsiventrally compressed.

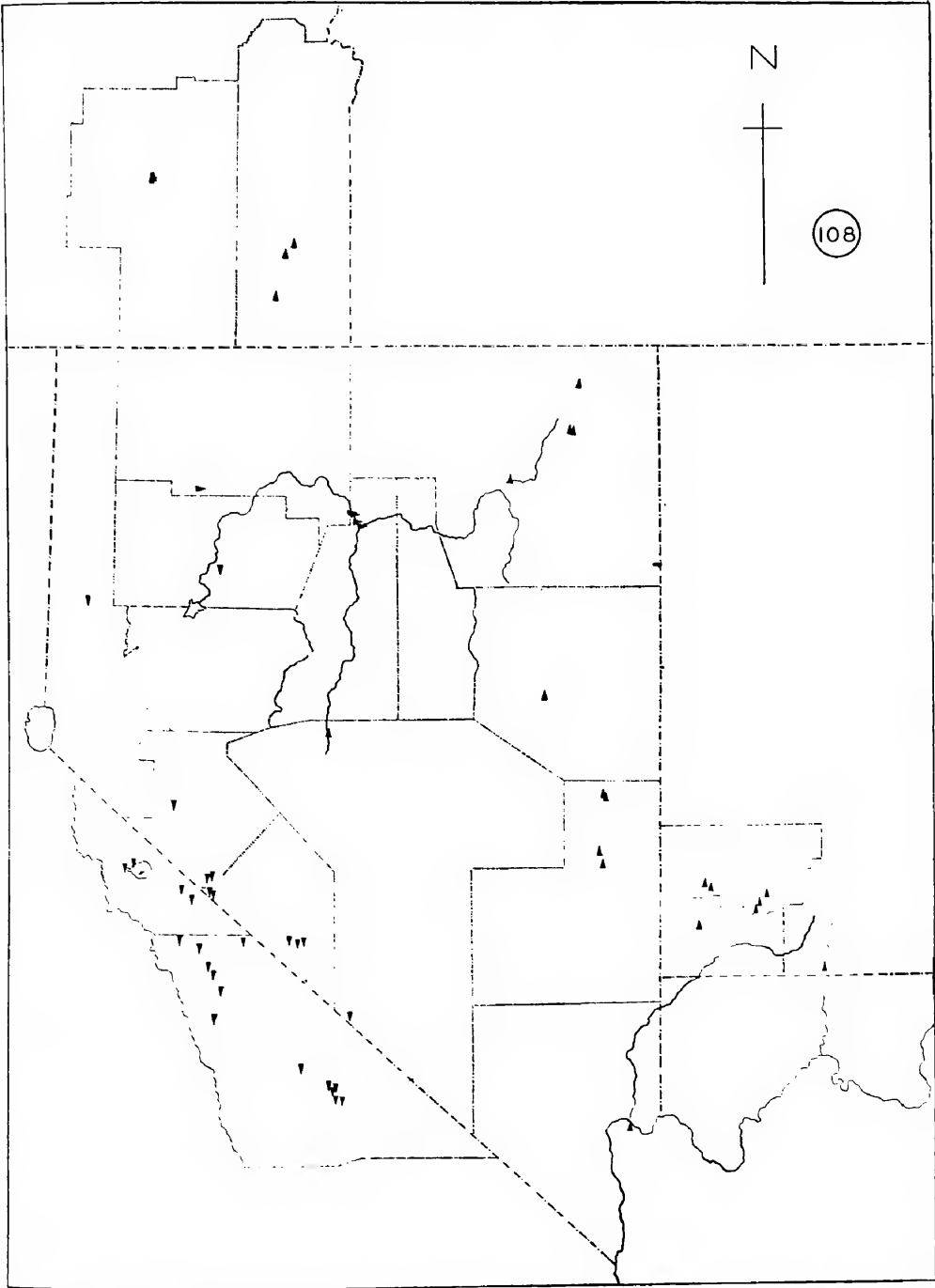
Key to the Species of sect. *Pterocarpi*

1. Leaflets 3–7 (9), or absent from some upper leaves, all 1–5 cm. long and decurrent into the rachis; *pod* strongly obcompressed, shieldlike, over 1 cm. wide but only $\pm$ 3 mm. thick (from one suture to the other), the lateral angles wing-margined lengthwise; *ovules* 42–60. Local in the Humboldt Valley, n.-centr. Nevada 246. *A. pterocarpus*
1. Leaflets either more numerous, or joined to the rachis, or both, averaging much shorter; *pod* otherwise; *ovules* 32–42 (2)
2. Leaflets all petiolulate; *pod* moderately obcompressed, not winged, the lateral angles obtuse; w. Nevada and adjoining California 245. *A. Casei*
2. Leaflets petiolulate or decurrent, but the terminal one of at least some upper leaves continuous with the rachis; *pod* (when ripe, or when dried in the fully formed stage) sharply 4-angled and 4-sided, the lateral angles and both sutures becoming salient and acute; s.-e. Oregon to centr. Nevada, s.-w. Utah, and n. Arizona 247. *A. tetrapteris*

245. *ASTRAGALUS CASEI*

Usually slender, somewhat wiry, with subterranean root-crown or shortly forking caudex (sometimes accidentally exposed by weathering), strigulose throughout with straight, filiform or flattened hairs up to 0.4–0.6 mm. long, the stems and herbage greenish or cinereous, the leaflets either equally pubescent on both sides or more densely so and canescent above; *stems* few or several, erect, or diffuse and ascending, (1) 1.5–4 dm. long, simple and leafless at base, divaricately branched or spurred at 1–4 nodes preceding the first peduncle, becoming stiff and zigzag distally; *stipules* (1) 2–5 mm. long, those at the buried and the first emerged nodes membranous, ovate, $\pm$ adnate to the suppressed or vestigial petiole, semi- or fully amplexicaul-decurrent, the upper ones herbaceous, cauline, with deltoid or triangular-acuminate, squarrose or deflexed blades; *leaves* 3–10 cm. long, shortly petioled, with (5) 9–15 rather distant, elliptic-oblong, oblanceolate, or linear, obtuse, retuse, rarely subacute, flat or folded leaflets 3–25 mm. long, all jointed to the rigid, tapering rachis; *peduncles* strictly erect or divaricate, 3–9 (12) cm. long, either longer or shorter than the leaf; *racemes* loosely (5) 8–20 (26)-flowered, the flowers at first ascending, declined in age, the axis elongating, (1.5) 3–12 (17) cm. long in fruit; *bracts* membranous, rarely green and firm, ovate or lanceolate, 2–3.5 (5) mm. long; *pedicels* at anthesis ascending, 1–1.8 mm. long, in fruit much thickened, recurved, 1.5–2.3 mm. long; *bracteoles* usually 2, sometimes up to 1 mm. long, rarely 0; *calyx* (5.8) 7.5–9 mm. long, strigulose with black, rarely white and a few black hairs, the subsymmetric disc 0.9–1.5 (2) mm. deep, the membranous, pallid or purplish, cylindric or exceptionally deep-campanulate tube (4.6) 5.8–7.5 mm. long, 2–3.5 mm. in diameter, rounded or more commonly tapering and turbinate at base, the subulate or triangular-subulate teeth 1.2–1.8 mm. long, the whole becoming hyaline, ruptured, marcescent; *petals* pink-purple with white wing-tips, rarely all white; *banner* varying from oblanceolate to broadly rhombic-obovate, shallowly notched, (12) 13.5–18 mm. long, 5.2–9.5 mm. wide; *wings* 11.3–15.5 mm. long, the claws 5.7–8.4 mm., the oblong-oblanceolate or narrowly oblong, obtuse, nearly straight blades 6.1–9 mm. long, 1.8–2.4 mm. wide; *keel* 10.6–13.3 mm. long, the claws 6–7.6 mm., the broadly lunate blades (4.6) 5–6.2 mm. long, 2.3–2.8 mm. wide, gently incurved through 80–95° to the rounded apex; *anthers* 0.55–0.75 (0.8) mm. long; *pod* deflexed, sessile, lance- or oblong-ellipsoid, 2–5.5 cm. long, (5) 6–10 mm. in diameter, commonly a little sigmoidally arched (decurved proximally and incurved distally) but sometimes straight or gently incurved its whole length, rounded or obtusely cuneate at base, gradually or abruptly contracted upward into a long-acuminate or shorter and triangular, laterally compressed, rigidly cuspidate beak, elsewhere obcompressed, the ventral face usually low-convex and obtusely carinate by the salient, cordlike suture (but this,

especially in strongly incurved pods, depressed and lying in a groove), the dorsal face either flattened or shallowly concave, the lateral angles rather narrow but obtuse, the fleshy, red- or brownish-mottled, strigulose valves becoming stiffly leathery, stramineous or brownish, transversely rugulose-reticulate, not inflexed; *dehiscence* apical, basal, and through the ventral suture; *ovules* 32-42; *seeds*



Map No. 108. Nevada and parts of adjoining states. Range of  *A. Casei*; of  *A. pterocarpus*; and of  *A. tetrapterus*.

brown, smooth or punctate, dull, 2.4–2.9 mm. long.—Collections: 26 (v); representative: *Maguire & Holmgren* 25,241 (ID, NY, SMU, RSA, UTC, WS); *Eastwood & Howell* 9539, 9557 (CAS); *Ripley & Barneby* 5890 (CAS, RSA); *Munz* 11,789 (CAS, POM).

Dry hillsides and valley floors, in alkaline gravelly soils overlying granite or basaltic bedrock, commonly in open places among sagebrush or in piñon-juniper forest, rarely on dunes, 4000–8000 feet, locally plentiful and rather frequent in Inyo and Mono Counties, California, from the Panamint Mountains north through Owens Valley to Mono Lake, and in western Nevada from Death Valley north, becoming local northward, to Pyramid Lake and the lower Humboldt River in Washoe and Pershing Counties.—Map No. 108.—April to June.

ASTRAGALUS CASEI (Eliphalet Lewis Case, 1843–1925) Gray, Bot. Calif. 1: 154. 1876.—“High plateau near Pyramid Lake, N. W. Nevada, *Lemmon* and *E. L. Case*.”—Holotypus, collected in 1875, GH! isotypus, US! presumed isotypi, labeled “California, *Lemmon* in 1875,” NY (2 sheets)!—*Tragacantha Casei* (Gray) O. Kze., Rev. Gen. 943. 1891. *Xylophacos Casei* (Gray) Rydb. in Bull. Torr. Club 52: 147. 1925.

In its area of dispersal the Case milk-vetch is easily recognized by its basally buried stems which branch upward and become stiff and zigzag distally, by its loose racemes of ascending, parti-colored flowers, and by the reflexed, handsomely mottled, unilocular pods of fleshy, ultimately leathery texture. Flowering specimens have sometimes been confused with the sympatric *A. Serenoi*, but this has few (5–11) longer, acute or mucronulate leaflets and a glabrous ovary. The pod of *A. Casei* is deciduous and opens after falling, while that of *A. Serenoi* persists on the raceme and can often be found the following spring attached to withered stems of the preceding season. The petals of *A. Casei* are normally pink-purple with contrasting white or pallid wing-tips, but albino mutants have been collected in the Panamints (*Dearing* 3188, SBM) and observed in quantity in Owens Valley. The pod varies greatly in length and in the development of the beak, which may be broadly deltoid or greatly drawn out into a triangular-acuminate point. As a rule the shorter pods are slightly and evenly incurved their whole length, whereas longer ones are gently sigmoid in profile, decurved out of the calyx and turning inward toward the beak.

In California the Case milk-vetch extends no farther south than Death Valley, Rydberg's record (1925, p. 148) from the San Bernardino Mountains being based on misidentification of an isotypus of *A. bicristatus* var. *tetrapteroides*. The plant from eastern Washington (*Brandege* 720) identified as *X. Casei* by Rydberg (l.c.) represents the quite different *A. (Argophylli) columbianus*.

246. ASTRAGALUS PTEROCARPUS

Sparsely leafy, somewhat wiry or juncaceous, with a shortly forking caudex or stout, multicapital root-crown just below soil-level, strigulose with filiform or commonly flattened, straight, appressed hairs up to 0.35–0.65 mm. long, the stems and lower leaf-surface thinly so, the herbage pallid or bluish-green when fresh, the leaflets densely silvery-canescens above; *stems* many, erect, the outer ones decumbent and ascending, (1) 1.5–3.5 (4) dm. long, simple and leafless at base, branching at 1–3 nodes preceding the first peduncle, flexuous or zigzag distally, the branches interlacing and forming bushy clumps of low, rounded outline; *stipules* 2.5–7 mm. long, the lowest ones scarios, obtuse, almost fully amplexicaul, free, the upper ones firmer or herbaceous, narrower, with deltoid, triangular-acuminate, or lanceolate, erect or deflexed blades; *leaves* (3.5) 5–10 cm. long, shortly petioled, with 1–3 (4) distant pairs of linear-acuminate or linear, acute or subacute, flat, dorsally keeled leaflets 1–5 cm. long, all continuous with the slender, grooved rachis, sometimes reduced in size or absent in the uppermost leaves, the terminal one represented by a linear, tapering production of the rachis and usually much longer than the last pair; *peduncles* at first ascending, then bent downward by weight of the succulent fruits, (4) 5–11 (15) cm. long, usually surpassing the leaf; *racemes* loosely but shortly 5–15-flowered, the flowers ascending, becoming horizontal in age, the axis little elongating, (1) 2–8 cm. long in fruit; *bracts* mem-

branous, ovate- or lance-acuminate, 1–5 mm. long; *pedicels* at anthesis ascending, 1.2–2.2 mm. long, in fruit arched out- or downward, thickened, 1.8–2.8 mm. long; *bracteoles* 0–2, usually present, scarious; *calyx* 9–12 mm. long, pilosulous with black or mixed black and white hairs, the pallid, membranous, cylindric but often basally tapering tube 7–8.5 mm. long, 2.8–3.6 mm. in diameter, the subulate teeth 2–4 mm. long, the ventral pair often a trifle the longest, the whole becoming hyaline, irregularly circumscissile; *petals* purple or whitish tipped with purple (not seen fresh), the banner with a pale, striate eye in the fold; *banner* broadly rhombic-oblongate, 16.3–19 mm. long, 7.4–9.2 mm. wide; *wings* 13.8–16.7 mm. long, the claws 7.4–9 mm., the oblong or oblong-obovate, obtuse, straight or distally incurved blades 7–8.6 mm. long, 1.9–2.8 mm. wide; *keel* 12.8–15.5 mm. long, the claws 7.5–9 mm., the half-obovate blades 5.9–7 mm. long, 2.6–3.2 mm. wide, gently incurved through 80–95° to the blunt apex; *anthers* (0.55) 0.6–0.9 mm. long; *pod* pendulous, sessile, elliptic or broadly oblong-oblongate in dorsiventral view, (2.5) 3–4.5 cm. long, (1.1) 1.3–1.7 cm. wide, nearly straight or obscurely sigmoid-arcuate below the decidedly incurved, triangular-acuminate, laterally flattened beak, the body very strongly obcompressed and hardly more than 3 mm. thick, the ventral face widely and shallowly grooved, the dorsal face flat or commonly low-convex, the lateral angles narrow but obtuse when fresh, at length margined all around, except at very base and in the beak, with a thin, rigid wing 2–3 mm. wide, the sutures both prominent, the ventral one depressed and the two subcontiguous within the cavity, the pale green, subtranslucent, smooth, fleshy, glabrous valves shrinking in ripening, ultimately leathery, stramineous, lustrous, transversely rugulose-reticulate, not inflexed; *dehiscence* basal and upward through the ventral suture, and simultaneously through the beak; *seeds* brown, smooth or sparsely punctate, 2–3.4 mm. long.—Collections: 8 (ii); representative: *Jones* 3835 (CAS, ORE, POM), in *May*, 1903 (CAS, POM, US, WS), 25,439 (CAS, POM); *Ripley & Barneby* 6169 (CAS, GH, NA, NY, RSA).

Low gullied hills and alkaline sandy flats, saltgrass meadows, and openings among halophytic shrubs, 4450–4500 feet, local but forming colonies, fairly frequent along the Humboldt River from near Battle Mountain downstream about 10 miles, in southeastern Humboldt and adjacent Lander Counties, Nevada; also about 80 miles to the west in southcentral Humboldt County (near Jungo).—Map No. 108.—April to June.

ASTRAGALUS PTEROCARPUS (with winged fruits) Wats., Bot. King 71, Pl. XII, fig. 1. 1871. —“... near the junction of Reese River with the Humboldt, Nevada... [Watson No.] 272.”—Holotypus, collected in September, 1868, US! isotypi, GH, NY!—*Tragacantha pterocarpa* (Wats.) O. Kze., Rev. Gen. 947. 1891. *Pterophacos pterocarpus* (Wats.) Rydb. in N. Amer. Fl. 24: 308. 1929.

The sparsely leafy, somewhat rushlike stems of the winged milk-vetch and its few decurrent leaflets, often reduced in size or altogether lacking in the upper leaves, are reminiscent of some seleniferous *Pectinati*, but these differ greatly in their connate stipules and persistent fruits of altogether different shapes. Only *A. toanus* of sect. *Pectinati* extends west as far as the Humboldt Valley, and this is distinguished further by its short leaflets and narrowly ascending, more loosely racemose flowers. The exceptionally long and narrow leaflets of *A. pterocarpus*, silvery-canescens above and glabrescent beneath, are remarkable enough in their own way, but the pod cannot fail to arouse a sentiment of admiration mingled with wonder. The large, fully formed but as yet unripe, shieldlike fruit is perfectly smooth, succulent, and of a pale green, semitranslucent substance suggestive of worked jade. At this stage the lateral angles (illustrated in Barneby, 1956, frontispiece) are relatively thick and rounded and the whole fruit heavy with juice. During the process of ripening, the sap is withdrawn from the fleshy mesocarp; as the watery tissues collapse inward, the sharp, thin, but rigid wings assume their characteristic form. The dry, fully ripe pod is leathery, straw-colored, lustrous, and prominently cross-reticulate. In the sum of all its characters the fruit of the winged milk-vetch is unique; but it is interesting that laterally winged pods, comparable in external form even though much smaller,

thinner-textured, and bilocular, have evolved in two annual astragali, closely related neither to one another nor to *A. pterocarpus*, the central Asiatic *A. Thlaspi* Lipsky and the Mexican *A. scutaneus*.

The winged milk-vetch was said by Jones (Contrib. West. Bot. 17: 12) to have been "obliterated at the type-locality" by 1930. However, a vigorous colony was still thriving at the mouth of the Reese River in the summer of 1944, and the species is certainly holding its own on the flood-plain of the Humboldt River downstream from Battle Mountain. Colonies vary in extent from year to year, but as the plants are apparently avoided by cattle, the species is in no immediate danger of extermination.

247. ASTRAGALUS TETRAPTERUS

Relatively robust but often of low stature, with a buried root-crown and ultimately woody caudex, strigulose in variable degrees with filiform or somewhat flattened, straight, appressed or subappressed hairs up to 0.3–0.5 mm. long, the stems and herbage varying from silvery or cinereous to pallid or dark green and nearly glabrous, the leaflets usually more densely pubescent above than beneath, occasionally glabrous above; *stems* several, rather closely tufted, at first erect or ascending but becoming diffuse or decumbent when weighed down by copious fruit, 1–3 (3.5) dm. long, simple, leafless, and subterranean for a space of 2–7 cm., thereafter leafy and branched or spurred at 1–6 nodes preceding the first peduncle, the primary branches often again branched or spurred, the spurs sometimes paired with a peduncle; *stipules* 2–5.5 mm. long, those at the buried and first emerged nodes scarious, pallid or purplish, strongly adnate to a vestigial or suppressed petiole to form a bidentate, semi- or almost fully amplexicaul sheath, the upper ones cauline, with triangular or triangular-acuminate, mostly reflexed, herbaceous blades; *leaves* (1.5) 2.5–8 cm. long, shortly petioled, with 9–21 linear, linear-oblong, narrowly elliptic, or rarely oval, obtuse to very acute, flat or folded, rigid and dorsally keeled or submembranous and flaccid leaflets 1–20 mm. long, the leaflets subhomomorphic throughout the plant, or dimorphic, those of the lower leaves then broader and more obtuse, the terminal leaflet, at least of some upper leaves, continuous with the rachis, the lateral ones either similar or all jointed; *peduncles* ascending, or in fruit divergent, 1–5 (6.5) cm. long, nearly always surpassed by the leaf; *racemes* shortly and rather closely 6–15-flowered, the flowers ascending at anthesis, the axis little elongating, 1–4 cm. long in fruit; *bracts* membranous becoming scarious, 1.5–3.5 mm. long; *pedicels* at anthesis slender, erect, 1.4–3 mm. long, in fruit a trifle thickened, arcuate-recurved, 2–4.3 mm. long; *bracteoles* commonly 2, minute or up to 1.5 mm. long, rarely 0; *calyx* 5.5–8.5 mm. long, strigulose with black or with black and some white hairs, the disc (0.8) 1–1.4 mm. deep, the membranous, pallid, cylindric or cylindro-campanulate or narrowly vase-shaped tube 4.7–7 mm. long, 2.3–3.1 mm. in diameter, the subulate or triangular-subulate, mostly obtuse, erect or spreading teeth 0.8–2.4 mm. long, the whole usually becoming hyaline, fragile, irregularly circumsissile, but sometimes papery and marcescent; *petals* whitish tinged with lilac, yellowish tinged with pink, or bright pink-purple with paler wing-tips, the color fugitive in drying; *banner* oblanceolate or rhombic-elliptic, emarginate to deeply notched, (13.5) 15–19 mm. long, 4.2–8 mm. wide; *wings* 11.6–16.5 mm. long, the claws 5.5–7.5 mm., the narrowly lanceolate or oblong, obtuse, obliquely truncate, or rarely retuse, straight or slightly incurved blades 6.6–10.2 mm. long, 1.5–2.4 (2.9) mm. wide; *keel* 10.2–13 mm. long, the claws 5.5–7.2 mm., the broadly lunate or half-elliptic blades 4.4–5.8 (6.3) mm. long, 2.1–2.7 (3.2) mm. wide, gently incurved through 80–90 (95)° to the bluntly deltoid apex; *anthers* (0.5) 0.55–0.7 mm. long; *pod* pendulous, sessile, obliquely oblong or broadly clavate-oblong in profile, crescentically incurved or coiled into a ring, 2–4 cm. long, (4) 6–10 mm. in diameter, nearly always broadest above the middle and tapering toward the obtusely cuneate base, abruptly

contracted distally into a short, deltoid, cuspidate beak, when first formed succulent and a trifle obcompressed, ultimately (by collapse of the fleshy walls lengthwise along the sides of both sutures) becoming sharply tetragonal, both sutures then salient and acute and the lateral angles winged lengthwise (the wings up to 2.5 mm. wide), the 4 subequally wide faces all concave, the glabrous or thinly strigulose valves at first green or purple-mottled, becoming stiffly papery, stramineous or brownish, smooth but cross-reticulate, lustrous, not inflexed; *dehiscence* both apical and basal, the valves gaping distally and tending to coil out- and backward; *ovules* 28–38; *seeds* olivaceous or khaki-brown, rugulose-punctate but somewhat lustrous, 1.8–2.7 mm. long.—Collections: 22 (vi); representative: *Peck 20,613* (WILLU), 21,695 (CAS); *Eastwood & Howell 277, 287* (CAS); *Maguire & Holmgren 25,484* (NY, UTC, WS); *Jones 5200* (NY), 5210 (POM); *Ripley & Barneby 6090* (CAS, NY, RSA), 6163, 6269 (CAS, RSA).

Gullied bluffs, barren knolls, and open valley floors, in loose sandy alkaline soils, mostly in exposed places but sometimes taking shelter under or entangled in sagebrush, commonly between 3500 and 6500 feet, but probably lower at its southern limit along the Colorado River, widely dispersed but uncommon, southeastern Oregon (about Malheur and Harney Lakes and along the Owyhee River) south through eastern Nevada to the Colorado Valley in northwestern Arizona and the Zion region in southern Iron, Washington, and western Kane Counties, Utah, west in Nevada to the headwaters of the Reese River in Nye County.—Map No. 108.—Late April to early July.

ASTRAGALUS TETRAPTERUS (four-winged, of the pod) Gray in Proc. Amer. Acad. 13: 369. 1878.—“Southern Utah, Mrs. Thompson and Capt. Bishop, in flower (1871–73), and now (1877) found by Dr. Palmer in fruit, 25 miles north of St. George.”—Lectotypus, *Palmer 111*, GH! isotypi, K, NY! paratypus (*Thompson & Bishop*), GH!—*Pterophacos tetrapteris* (Gray) Rydb., Fl. Rocky Mts. 1063. 1917. *Astragalus tetrapteris* var. *typicus* Barneby in Leaflet. West. Bot. 4: 234. 1946.

Astragalus tetrapteris var. *capricornus* (ram's-horn, the pod's valves coiled in dehiscence) Jones, Rev. Astrag. 149, Pl. 31. 1923.—“... at Cobre, Nevada.”—Lectotypus, collected June 16, 1906, by M. E. Jones, POM! isotypi, CAS, NY!

Pterophacos cinerascens (turning ashen, of the pubescent foliage) Rydb. in N. Amer. Fl. 24: 309. 1929.—“Type collected... southwest of Narrows, Harney County, Oregon, July 4, 1912, *Morton E. Peck 3024*...”—Holotypus, GH! (apparently no isotypus retained in herb. Peck., WILLU).—*Astragalus cinerascens* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937. *A. tetrapteris* var. *cinerascens* (Rydb.) Barneby in Leaflet. West. Bot. 4: 235. 1946.

The four-winged milk-vetch, *A. tetrapteris*, is somewhat isolated taxonomically in relation to the two foregoing *Pterocarpi*. It might be more consistent with standards adopted elsewhere in this volume to provide for it a separate subsection, possibly a monotypic section. However the fruit, as first fully developed, is not different in any essential feature from that of *A. Casei* or of several *Argophylli* at the same stage of growth, the unique tetragonal compression being assumed only as the pulpy tissue of the mesocarp collapses inward in drying. Jones (1923, p. 148) pointed out that the cavity of the pod is transversely linear, indicating a primitively dorsiventral compression and the quadrangular, ripe section is apparently the result of stresses set up within the valve-walls during the process of maturing. The lustrous, reticulate exocarp is like that found in *A. pterocarpus*.

The species is superficially polymorphic. The vestiture varies greatly in density and somewhat in distribution. The leaflets vary from flat, membranous, and mostly jointed to the rachis to involute, stiff, and decurrent. The flowers vary in size and coloring, sometimes in the same colony. In fact, hardly two populations are similar in all respects. The differential characters of likely use in the definition of geographic varieties within *A. tetrapteris* have been shown (Barneby, 1946, p. 234–236) to occur in a number of intergradient and interlocking combinations, and the var. *cinerascens*, arbitrarily defined by a glabrous pod, seems little better than one of a number of minor variants of equal stature. A hairless pod was formerly known only from southeastern Oregon, but even there it does not wholly replace the more ordinary pubescent form. Moreover, part of the type-collection of the certainly inconsiderable var. *capricornus* (CAS) has a glabrous pod, even though it came from a region where a pubescent ovary is more commonly encountered. In general, the more xerophytic type (= var. *capri-*

cornus) becomes prevalent in the northern half of the species-range and the type with expanded, jointed, lateral leaflets is commoner southward. But intergradation between the extremes is continuous, and the extreme types do not seem to be firmly correlated with any edaphic or distributional factor.

In southwestern Utah *A. tetrapteris* has caused loco-disease (near Newcastle, acc. Marsh & Clawson in U. S. Dept. Agr., Dept. Circ. 81, 2 figs. 1920); it is very possible that all the *Pterocarpis* are poisonous. Fortunately none is really abundant, except very locally, and I believe that they are seldom browsed.

LXVI. Sectio ANEMOPHILI

Caulescent perennials with superficial root-crown and stems at length basally indurated; *vesture* basifixed, tomentulose or villous-tomentulose, copious; *stipules* all (or at least the lower ones) connate, dorsally tomentulose like the stems; *leaves* imparipinnate, with 17–35 leaflets; *flowers* ascending, rather closely racemose, of moderate size, the banner 11.5–16 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* whitish or ochroleucous, sometimes lilac-tinged, regularly or irregularly graduated, either the banner or the wings longest, the keel shortest, obtuse; *pod* ascending or spreading, sessile, deciduous, obliquely ovoid, bladderly-inflated, uni- or subunilocular, the valves papery; *dehiscence* apical, after falling; *ovules* 22–40.—Spp. 3, maritime xerophytes, of northern Baja California and islands off the coast of southern California.

ASTRAGALUS sect. ANEMOPHILI, sect. nov., omnibus fere notulis nisi indumento tomentuloso et praesertim stipulis inter se connatis cum *Inflatissimis* congruentes, a sect. *Densifoliis* quoad legumen sessile maxime inflatum comparandis floribus ad anthesin adscendentibus nec nutabundis stipulisque parvulis extus tomentulosis nec scariosis dorso glabratis absimiles.—Sp. typica: *A. anemophilus* Greene.

The general affinities of the *Anemophili* to the groups of species characterized by deciduous, sessile, bladderly pods are unlikely to be questioned, but their closer ties are controversial. The section conforms with sect. *Inflatissimis* except for the softly tomentulose vesture and, more importantly, the connate stipules. However, no particular member of sect. *Inflatissimis* can be singled out as nearly related to any member of the *Anemophili*, least of all *A. magdalenae*, despite its adaptation to a maritime dune habitat. Some species of *Densifolii* are technically similar so far as the large, sessile, swollen fruit is concerned, and one of these is both coastal and often tomentulose; but its nodding, differently proportioned flowers and large, scarious, dorsally glabrate stipules are significantly different. The two *Anemophili* known to Jones, *A. miguelensis* and *A. anemophilus*, were placed (1923, p. 110–111) in a subdivision of *Inflatissimis* including also the *Densifolii*, and they formed an atypical part of *Phaca* sect. *Candidissimae* Rydb.

Key to the Species of Sect. Anemophili

1. Plants tomentulose throughout, but the pod more thinly so than the almost pannose leaves and stems; *pod* 1.6–4 cm. (in Baja California 2.7–4 cm.) long; *ovules* 27–40 (at least 30 in Baja California) (2)
2. Calyx-teeth triangular or broadly triangular-subulate, 0.8–1.5 mm. long; *flower* blunt in profile, the banner 11.5–12.7 mm. long, recurved through $\pm 80^\circ$, the wings as long or slightly longer, the keel (10–11 mm. long) not much shorter; *leaflets* 19–35 (37); *pod* 3–4 cm. long; San Quintín Bay and vicinity, Baja California 248. *A. anemophilus*
2. Calyx-teeth broadly subulate, 2.3–3.5 mm. long; *flower* not blunt in profile, the banner 12.5–16 mm. long, recurved through $\pm 45^\circ$, either longer or shorter than the wings but considerably surpassing the keel (9–12 mm. long); *leaflets* 21–27; *pod* averaging smaller, 1.6–3.6 cm. long; islands off the coast of s. California 249. *A. miguelensis*
1. Plants villous-tomentulose up to the inflorescence, the pod 1.4–2 cm. long, loosely strigulose; *ovules* 22–27; n. Baja California 250. *A. Harbisonii*

248. ASTRAGALUS ANEMOPHILUS

Diffuse, trailing, or somewhat bushy-branching perennials, with a long tap-root and at length basally indurated stems (often submerged in shifting sands),

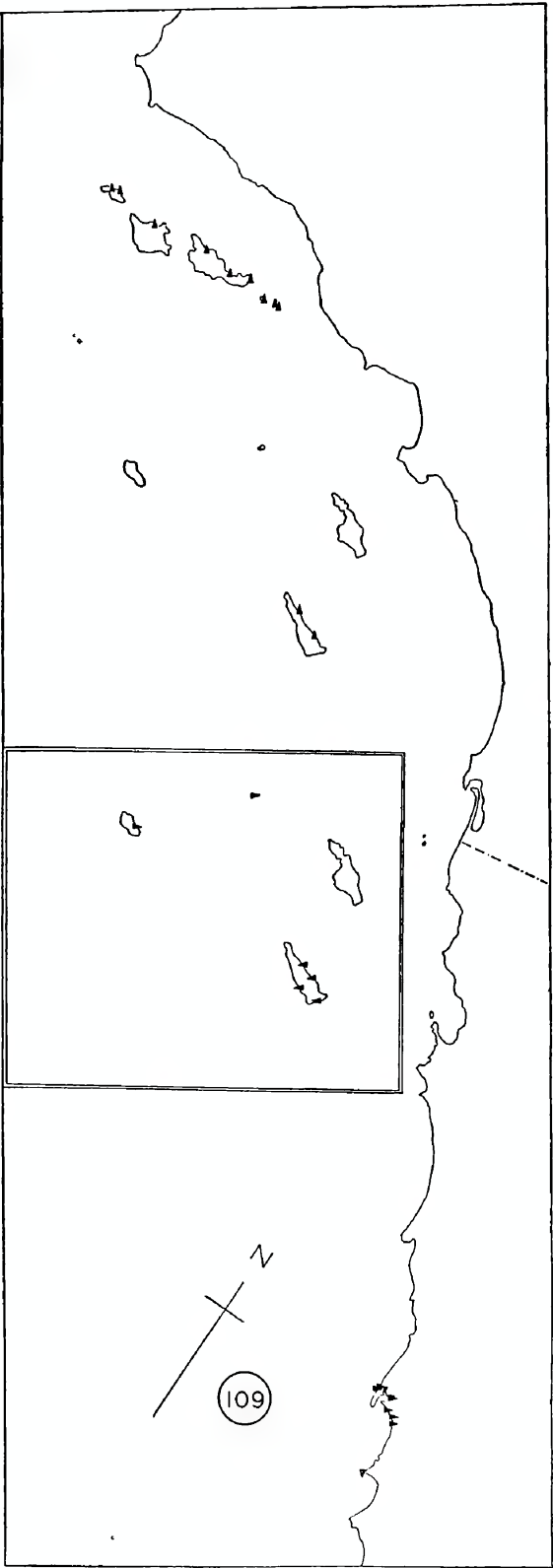
densely and softly tomentulose throughout with fine, curly, entangled hairs up to 0.6 mm. together with a very few longer, almost straight, ascending hairs up to 1 mm. long, the stems and herbage white, the leaflets sometimes becoming greenish-gray in age; *stems* about 2.5–3.5 dm. long, freely branching or spurred toward the base, flexuous distally; *stipules* thinly herbaceous becoming papery, 2.5–8 mm. long, all amplexicaul and connate through $\pm \frac{1}{3}$ of their length into a dorsally tomentulose, sometimes finally ruptured sheath, with short, broadly triangular-acuminate, erect blades; *leaves* 4–9 cm. long, shortly petioled or the uppermost sessile, with 19–35 (37) broadly elliptic, broadly obovate, or suborbicular, very obtuse or subretuse, flat or loosely folded leaflets (2) 4–14 mm. long; *peduncles* stout, incurved-ascending, 8–15 cm. long, commonly weighed down by the fruit; *racemes* rather closely 15–23-flowered, the flowers loosely ascending or spreading, the axis a little elongating, 3–7 cm. long in fruit; *bracts* papery-membranous, ovate, acute, 1.7–2.7 mm. long; *pedicels* ascending, straight or a trifle arched outward, at anthesis 1–1.5 mm., in fruit thickened, persistent, 2–3 mm. long; *bracteoles* rudimentary or 0; *calyx* 6–6.5 mm. long, tomentulose like the leaves but somewhat less densely so, the strongly oblique or subsymmetric disc 0.9–1.5 mm. deep, the campanulate or somewhat ovoid-campanulate, purple-tinged tube 4.3–5.2 mm. long, 3.5–4.1 mm. in diameter, the triangular or broadly triangular-subulate teeth 0.8–1.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* ochroleucous; *banner* abruptly recurved through $\pm 80^\circ$, 11.5–12.7 mm. long, the short, broadly cuneate claw expanded into a rhombic-ovate or -suborbicular, notched blade 6.8–8.8 mm. wide; *wings* as long or a trifle longer than the banner, 11.5–12.8 mm. long, the claws 5.2–6 mm., the broadly oblong, obtuse, nearly straight blades 7–8.6 mm. long, 2.8–3 mm. wide; *keel* 10–11 mm. long, the claws 5–6.2 mm., the half-obovate blades 5.4–5.7 mm. long, 2.7–3.2 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the bluntly triangular, sometimes subporrect apex; *anthers* 0.55–0.85 mm. long; *pod* spreading or loosely ascending, sessile, obliquely ovoid, bladderly-inflated, (2.7) 3–4 cm. long, 1.5–2.2 (or when pressed seemingly up to 2.7) cm. in diameter, broadly obconic at base, contracted distally into a short, triangular, laterally compressed beak, shallowly sulcate ventrally and obscurely so dorsally, the ventral suture nearly straight or much less strongly convex than the dorsal one, the thin, pale green often purple-spotted but unmottled valves tomentulose with extremely fine, curly hairs, becoming stramineous, papery, delicately reticulate, not inflexed, the funicular flange $\pm 0.5\text{--}0.7$ mm. wide; *ovules* 32–40; *seeds* brown, smooth but dull, 2.3–2.6 mm. long.—Collections: 7 (i); representative: *Orcutt 1325* (NY); *Raven, Mathias & Turner 12,418* (CAS); *Harbison & Higgins* (from Colonia Garcia) in 1953 (RSA); *Wiggins 11,282* (DS), *11,884* (DS, UC).

Mobile and partly stabilized dunes below 30 feet, locally abundant around San Quintín Bay, Baja California.—Map No. 109.—December to May, probably intermittently through the year.

ASTRAGALUS ANEMOPHILUS (wind-loving, “exposed to the incessant winds of that point of the coast”) Greene in Bull. Calif. Acad. Sci. 1: 186. 1885.—“Cape San Quintín, Lower California, May 10, 1885.”—Holotypus, collected by E. L. Greene, CAS! isotypi, DS, ND, NY!—*A. Crotalariae* var. *anemophilus* (Greene) Jones, Contrib. West. Bot. 10: 59. 1902.

Phaca vestita (clothed, of the dense tomentulose vesture) Bth., Bot. Sulphur 13. 1844.—“Bay of Magdalena, and San Quintín.”—Holotypus, collected by Hinds, doubtless at San Quintín and not at Magdalena Bay, K!—*Astragalus vestitus* (Bth.) Wats., Bibl. Ind. 202. 1878 (non Bss. & Heldr., 1849). *Tragacantha vestita* (Bth.) O. Kze., Rev. Gen. 949. 1891.

The San Quintín milk-vetch is an exceptionally handsome species, notable for the dense, soft tomentum clothing the whole plant up to the rather small, whitish flowers, the many short leaflets of broad outline, and the large size of the purple-dotted (in general effect pink-



cheeked), rather firmly papery, but greatly swollen pods. The plants occur in quantity over the barrier dunes along the ocean near San Quintín and at Socorro, where they form entangling masses of white stems and foliage often partly engulfed by movements of the sand. The species was first collected by Hinds in flower only, but *Phaca vestita* is readily recognizable from Bentham's description of the vesture, connate stipules, and other features. The attribution of *P. vestita* to Magdalena Bay as well as San Quintín is almost certainly incorrect, however. It is known that some of Hinds' and Sinclair's labels were transposed, and the dune astragalus common (and the only one of its sort since encountered) at Magdalena Bay is *A. magdalenae*, also first collected on the cruise of the "Sulphur" and described as *Phaca candidissima* by Bentham in the same work. The more southern plant differs greatly in its appressed, satiny pubescence, free stipules, and differently proportioned, purple flowers. Except for the closely related *A. Harbisonii* mentioned below, *A. anemophilus* is the only perennial astragalus with sessile and inflated fruit known from the west coast of northern Baja California.

The species was recorded by Rydberg (1929, p. 349) with a note of doubt from San Miguel Island off the coast of Alta California; but the only specimen so annotated in his hand at NY is an isotypus of *A. miguelensis*, a fact which serves to emphasize the close relationship between these two maritime vetches. The characters contrasted in the key to the section are not especially strong ones, but the average specimen of *A. miguelensis* is so easily distinguished by its smaller pod, more often than not narrowly septiferous within, and the more nearly ordinary graduation of the petals, that it seems reasonable to maintain them as specifically distinct.

249. ASTRAGALUS MIGUELENSIS

Diffuse, perennial, with a taproot and at length basally indurated stems, densely woolly-tomentulose with extremely fine, curly or contorted, entangled hairs up to 0.6–1 mm. long, the young stems and foliage white-pannose, becoming gray or greenish-gray in age; *stems* several or numerous, decumbent and ascending, (1.5) 2–3 dm. long, commonly branched at 1–3 (5) nodes preceding the first peduncle, flexuous or zigzag distally; *stipules* submembranous becoming firmly papery, 2–5.5 mm. long, tomentulose externally, all amplexicaul and connate, the lower ones through half their length into a short, campanulate sheath, the upper ones more shortly and sometimes obscurely so (the sheath often ruptured by expansion of the stem), with deltoid or triangular-acuminate free blades; *leaves* (2.5) 4–12 cm. long, shortly petioled, mostly arcuate-recurved, with (17) 21–27 oblong-oblan-ceolate, -obovate, or -ovate, retuse or obtuse, flat or loosely folded leaflets (3) 6–12 (22) mm. long; *peduncles* rather stout, (3) 5–13 cm. long, about equaling the leaves, the uppermost often shorter; *racemes* at first rather dense, 10–30-flowered, the flowers ascending, spreading or a trifle declined in age, the axis not greatly elongating, (1) 2–9 cm. long in fruit; *bracts* submembranous, dorsally tomentulose, triangular, lanceolate, or lance-acuminate, 2–3.5 mm. long; *pedicels* ascending, straight or slightly arched outward, at anthesis 0.8–1.7 mm., in fruit 2–3 mm. long; *bracteoles* 0–2, minute when present; *calyx* 6.6–7.9 mm. long, white-tomentulose like the herbage, the subsymmetric disc 1–1.6 mm. deep, the campanulate tube 4.1–4.8 mm. long, 3.1–3.9 mm. in diameter, the broadly sub-ulate teeth 2.3–3.5 mm. long, the whole becoming papery, marcescent but ruptured; *petals* whitish or ochroleucous, concolorous, drying yellowish; *banner* recurved through $\pm 45^\circ$ (further only when withering), broadly obovate-cuneate or rhombic-oblan-ceolate, 12.5–16 mm. long, (6) 6.8–8.2 mm. wide; *wings* (2 mm. shorter to 1.3 mm. longer than the banner) 11.6–16 mm. long, the claws 4.5–6.7 mm., the narrowly oblong or oblan-ceolate, obtuse or erose-emarginate, straight blades 7.7–9.8 mm. long, (2.2) 2.5–3.6 mm. wide; *keel* (9) 9.3–12 mm. long, the claws 4.6–6.5 mm., the half-obovate blades 5–6.2 mm. long, 2.3–3.3 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the bluntly deltoid apex; *anthers*

Map No. 109. Pacific Coast in lat. $29^\circ 30'\text{--}34^\circ 30'$, southern California and northern Baja California. Range of $\blacklozenge$ *A. anemophilus*; of $\blacktriangle$ *A. miguelensis*; and of $\blacklozenge$ *A. Harbisonii*. In-set, the southern group of islands. Range of $\blacklozenge$ *A. Nevinii*; and of $\blacklozenge$ *A. Traskiae*.

0.55–0.8 mm. long; *pod* spreading, sessile, obliquely ovoid-acuminate, bladdery-inflated, obtuse at base, contracted distally into a deltoid or triangular-acuminate, laterally flattened beak, 1.6–2.6 cm. long, (0.9) 1.3–2.3 cm. in diameter, the body a little dorsiventrally compressed, shallowly and openly sulcate along the ventral or both sutures, the thin, pale green or purplish, finely tomentulose valves becoming papery, stramineous, subdiaphanous, delicately cross-reticulate, not inflexed or inflexed as a very narrow septum up to 0.9 mm. wide, the funicular flange also narrow, not over 0.6 mm. wide; *ovules* 27–40; *seeds* brown, sometimes purple-dotted, smooth but dull, 1.8–3 mm. long.—Collections: 18 (o); representative: *Clokey* 4988 (NY, WS); *Moran* 3445 (CAS, NY, UC); *J. T. Howell* 3799 (CAS); *Abrams & Wiggins* 268 (CAS); *Munz* 6606 (POM, NY); *Trask* 16 (US); *Raven* 17,259 (CAS).

Rocky slopes, wind-swept bluffs overlooking the ocean, and beaches or sandy talus beneath sea cliffs, mostly below 500 feet, locally plentiful on the Santa Barbara Channel Islands, California (San Miguel, Santa Cruz, Santa Rosa, Anacapa); San Clemente Island.—Map No. 109.—March to July, and intermittently through the year.

ASTRAGALUS MIGUELENSIS (of San Miguel Island) Greene in Pittonia 1: 33. 1887 ("Miguelensis").—No locality given, but evidently from San Miguel Island.—No material found (perhaps overlooked) at ND; presumed isotypi, collected on San Miguel by E. L. Greene in September, 1886, G, MO (*Greene* 3358), NY (2 sheets), ORE, PH!—*Phaca miguelensis* (Greene) Rydb. in N. Amer. Fl. 24: 348. 1929. *A. vestitus* var. *miguelensis* (Greene) Jeps., Fl. Calif. 2: 352. 1936.

The Channel Island milk-vetch, *A. miguelensis*, is the only insular Californian species with bladdery fruits sessile within the early ruptured calyx, the others having their swollen fruits elevated on either a stipe or gynophore. Its soft woolly-tomentulose vesture distinguishes it on the islands from all but *A. Nevinii* and *A. Traskiae*, which have free stipules and nodding, stipitate, uninflated and completely bilocular pods. Despite the differences in the stipules, flowering specimens of *A. miguelensis* do resemble both *A. Nevinii* and *A. Traskiae* and have given rise to misleading reports of these species from several islands to which they are not native. Only *A. Nevinii* is sympatric with *A. miguelensis*, and that only on San Clemente Island.

The fruit of *A. miguelensis* is variable in size and also in the width of the recessive fold arising within from the dorsal suture. Although always very narrow and sometimes obsolete (*Moran* 3445, NY) it is a true septum, and no mere inward elevation of the suture. On San Clemente Island, remote from the main group of Channel Islands, the pod tends to be smaller and also of slightly firmer texture than elsewhere, but the plants seem not to differ otherwise. The reduction of *A. miguelensis* to varietal rank under *A. anemophilus* (or *A. vestitus* Wats., non Bss. & Heldr.) was perhaps justified; there can be no doubt of the close relationship, mentioned under the preceding. However, Jepson's suggestion that the species is intermediate between *A. anemophilus* and *A. vestitus* var. *Menziesii* (= our *A. Nuttallii*) has no foundation in fact.

According to T. D. A. Cockerell, the Channel Island milk-vetch is a locoweed and avoided by sheep on San Miguel Island (*Cockerell* in 1937, K).

250. *ASTRAGALUS HARBISONII*

Slender, perennial but perhaps of short duration, densely villosulous-tomentulose with short, curly, and longer, nearly straight, ascending hairs up to 0.4–0.6 mm. long, the vesture somewhat lustrous and silky in youth, the herbage canescent, the leaflets pubescent on both sides; *stems* diffuse and ascending, 1.5–3 dm. long, simple or branched from the near the base upward, the internodes 1.5–5.5 cm. long; *stipules* thinly herbaceous becoming papery, broadly triangular, 3–5 mm. long, connate-amplexicaul, the lowest united through 1–2 mm., the upper ones more shortly so, sometimes joined by a stipular line; *leaves* 5–9 cm. long, the uppermost very shortly petioled, with (13) 17–23 broadly to narrowly elliptic, acute or subacute, flat leaflets 3–11 mm. long; *peduncles* at first erect, stiff, and

straight, probably decumbent in fruit, 2.5–10 cm. long, mostly longer than the leaves; *racemes* shortly and rather closely 13–23-flowered, the flowers ascending, the axis little elongating, 1.5–3.5 (5.5) cm. long in fruit, the pods crowded; *bracts* 1–3 mm. long; *pedicels* straight, ascending, at anthesis 0.5–1 mm. long, in fruit somewhat thickened, 1.2–2.4 mm. long; *bracteoles* 2; *calyx* 5.2–6.6 mm. long, villous-tomentulose with mixed black and white hairs, the subsymmetric disc 0.7–0.8 mm. deep, the membranous tube 3.5–4.1 mm. long, 2.9–3.2 mm. in diameter, the subulate teeth 1.7–2.5 mm. long, the whole becoming papery, ruptured, persistent; *petals* whitish $\pm$ tinged with lavender, the keel-tip maculate; *banner* recurved through 45°, rhombic-elliptic, shallowly notched, 12–12.2 mm. long, 6.5–6.7 mm. wide; *wings* 11.2–11.4 mm. long, the claws 4.6–4.8 mm., the oblong-oblongate, obtuse, nearly straight blades 7.7–7.9 mm. long, 2.4–3 mm. wide; *keel* 9.2–9.9 mm. long, the claws 4.7–5 mm., the half-obovate blades 5.1–5.5 mm. long, 2.6–2.7 mm. wide, incurved through 95° to the blunt apex; *anthers* 0.5–0.6 mm. long; *pod* ascending, sessile, obliquely ellipsoid, bladdery-inflated, 1.4–2 cm. long, 8–11 mm. in diameter, obtuse at base, contracted distally into a short, triangular, laterally flattened beak, the sutures both filiform, the ventral one either straight or much less convex than the dorsal, the thin, greenish, unmottled, strigulose valves becoming papery-membranous, semitransparent, stramineous, delicately reticulate, not inflexed; *ovules* 22–27; *seeds* brown, $\pm$ 2.5 mm. long (not seen quite ripe).—Collections: 3 (o); representative: *Moran 2024* (UC, RM).

Near sea level, the habitat not recorded, known only from the south end of San Quintín Bay (lat. 29° 57' N.), Baja California.—Map No. 109.—March to June.

ASTRAGALUS HARBISONII (Charles Francis Harbison, 1904—) Barneby in Leaf. West. Bot. 7: 34. 1953.—“MEXICO: Baja California (northern District): Punta Baja, 6 April 1950, Charles F. Harbison . . .”—Holotypus, SD! isotypus, RSA!

In general aspect the Harbison milk-vetch is reminiscent of *A. idrietorum* or of some forms of *A. Palmeri* found nearby but away from the coast in northern Baja California; but the technical features of tomentose vesture and connate stipules reveal its relationship to the *Anemophili* and not the *Inflatii*. In the form of the flower and mutual proportions of the petals, *A. Harbisonii* agrees more closely with *A. miguelensis* of the California Channel Islands than with *A. anemophilus*, its close neighbor on the dunes bordering the bay of San Quintín. From the latter it differs in its subacute leaflets, well-graduated petals tinged with lilac, and smaller, much fewer-ovulate, merely strigulose and not finely tomentulose pod of thinner, semitransparent texture.

LXVII. Sectio DENSIFOLII

Robust, amply leafy, caulescent perennials, with stout taproot, superficial (unless accidentally buried) root-crown, and stems (often fistular) at length indurated at base but hardly caudiciform; *vesture* basifixed, villous-villosulous, tomentulose, loosely strigulose, or almost wanting; *stipules* all, or at least the lowest, connate in vernal or permanently, commonly large, papery-scarious, and thinly pubescent or glabrous dorsally, in *A. pomonensis* all free; *leaves* imparipinnate, with 17–43 (always some with more than 21) leaflets; *flowers* numerous, (10) 15–90 (125), at least in early anthesis densely racemose, at full anthesis declined or nodding, of small or moderate size, the banner 7–19 mm., long; *pedicels* persistent; *calyx-tube* campanulate, in subsect. *Oxyphysi* cylindric or nearly so; *petals* greenish-white or ochroleucous, the keel sometimes faintly lilac-tipped, regularly or irregularly graduated, the banner often a little shorter than the wings, the keel obtuse; *pod* loosely ascending, spreading, or declined, sessile but sometimes elevated on a long, stipelike gynophore, in all but subsect. *Pycnostachyi* large, de-

ciduous, greatly inflated, apically dehiscent after falling, 12–55-ovulate (in *Pycnostachyi* small, tardily deciduous and perhaps indehiscent, little inflated, 3–12-ovulate), variably compressed, unilocular.

The *Densifolii*, a section of five species endemic to cismontane California and northern coastal Baja California, is important because of the size and abundance of the plants and especially because of the role played by the toxic *A. asymmetricus* and *A. oxyphysus* in the rural economy of the inner South Coast Ranges and Great Valley. The section is heterogeneous in technical attributes and is built up by accretion, passing by small modifications from one species to the next, but unquestionably natural. It is hard to define because of the paucity of features common to all the species; and these features, the comparatively many leaflets, the nodding flowers, persistent pedicels, and pod at once sessile and unilocular, are not of the first order. However, characters common to all but one species, especially the connate stipules and pod at once large, greatly swollen, deciduous (either from the receptacle or a gynophore), and apically dehiscent on the ground, serve to link together the discrepant parts.

The relationships of sect. *Densifolii* seem to lie in two directions: on the one hand, toward the free-stipuled, piptoloboid *Inflati* with which *A. Nuttallii* and *A. pomonensis* have traditionally been associated; and on the other, by way of the superficially similar, also cismontane, either free- or connate-stipuled but emmenoloboid sect. *Trichopodi* toward a more primitive homaloboid or phacoid type of *Astragalus* most highly developed in the arid interior. The *Trichopodi* are maintained here as forming a section apart from *Densifolii* on the basis of their persistent, stipitate pods; but the number of similarities, obvious and subtle, morphological and ecological, to be found in the pairs of species *A. (Densifolii) curtipes* and *A. (Trichopodi) trichopodus* var. *lonchus*, or *A. (Densifolii) oxyphysus* and *A. (Trichopodi) asymmetricus* is too great to be explained in terms of coincidence, even though the nature of the relationship is not known. Considered as a unit, the sects. *Densifolii* and *Trichopodi* present a vexatious stumbling-block to my attempts at a logical classification of the American *Astragali*. The presumed phylogenetic significance of a persistent and stipitate as opposed to a sessile, readily deciduous fruit has been stressed repeatedly in this account, and even though several exceptions have been noticed, nowhere else is there so clear and unequivocal evidence of close relationship between emmenoloboid and piptoloboid groups. It is possible, however, that the two sections are phylogenetically impure, for the constituent species possess in different degrees a mixture of morphological characters proper to two widely divergent lines of development within the genus, lines represented today by the piptoloboid, free-stipuled *Inflati* and the emmenoloboid, connate-stipuled *Hookeriani*. At one end of a series of marvelous modifications is *A. trichopodus* var. *phoxus*, possessing, together with the many leaflets and free stipules of its cismontane relatives, the stipitate, uninflated, two-sided pod of *A. (Hookeriani) filipes*. A gradual passage can be traced through other varieties of *A. trichopodus* to a pod essentially like that of connate-stipuled *A. asymmetricus*, and differing only from that of *A. (Densifolii) curtipes* in having a stipe in place of a gynophore. Turning to the *Densifolii*, I note that connate stipules are prevalent, but the pod abruptly becomes sessile as in sect. *Inflati*, and the homaloboid characteristics become increasingly vague. Nevertheless, the lateral compression of the greatly inflated pod of *A. oxyphysus* and the tardy fall and dehiscence of the small, bicarinate pod of *A. pycnostachyus* are suggestive of homaloboid ancestry. At the other end of the series *A. Nuttallii*, with a pod truly sessile and readily deciduous, passes by way of var. *virgatus*, which has stipules progressively less connate, into the free-stipuled *A. pomonensis*, theoretically an almost perfect member of sect. *Inflati*.

The *Densifolii* proper, the homonymous subsection, has pods greatly swollen and similar in shape to that of *A. (Inflati) Douglasii*, and ovules relatively numerous, mostly over 18. The remaining species, *A. pycnostachyus* and *A. oxyphysus*, are distinguished by their more or less laterally compressed pods bicarinate by the salient sutures and fewer ovules; both are highly modified and represent distinct subsections.

Key to the Subsections of Sect. *Densifolii*

1. Pod either sessile on the almost flat receptacle or, if elevated on a gynophore, the gynophore glabrous; *body* of the pod greatly inflated, not compressed, the sutures not salient; *flowers* usually smaller than the next, the petals little or irregularly graduated, the banner 7–16 mm. long; *calyx-tube* campanulate, 3.5–5.7 (6) mm. long, 2.7–4.8 mm. in diameter; outer slope of the Coast Range (one rare inland in San Benito County), immediate shoreline, and insular (2)
2. Flowers relatively large, the banner (10) 11–16 mm., the keel 9.5–13 mm. long; *pod* (sessile or elevated on a gynophore) large, greatly inflated, 2–6 cm. long, not laterally compressed, the sutures not salient; *ovules* 16–55; often along the immediate coast but in dry habitats, not in coastal marshes

- LXVII (i). Subsect. *Densifolii*
 2. Flowers small, the banner 7–10 mm., the keel 7–9 mm. long; *pod* (sessile) small, 6–11 mm. long, not or little inflated, somewhat laterally compressed, the sutures salient; *ovules* 3–12; coastal marshes LXVII (ii). Subsect. *Pycnostachyi*
 1. Pod elevated on a densely villous gynophore, the body inflated but also laterally compressed, bicarinate by the sutures; *flowers* relatively large, the banner about 15.5–19 mm. long, the petals regularly graduated; *calyx-tube* cylindric or deeply campanulate, the tube 6–8.4 mm. long, 2.8–3.8 mm. in diameter. Pod large (mostly 2.5–4.5 cm. long) but *ovules* only 11–18; arid interior Coast Ranges and Great Valley LXVII (iii). Subsect. *Oxyphysi*

LXVII (i). Subsectio DENSIFOLII

Plants villosulous, strigulose, or nearly glabrous; *stems* prostrate, diffuse, or erect; differential characters as given in the subsectional key.—Spp. 3, xerophytes, of coastal central and southern California and northwestern Baja California, Channel Islands, and 1 rare inland in San Benito County.

ASTRAGALUS sect. DENSIFOLII (Rydb.), comb. nov., based on *Phaca* subgen. *Chartocystis* sect. *Densifoliae* Rydb. in N. Amer. Fl. 24: 346. 1929.—Sp. typica: *P. densifolia* Sm. = *A. Nuttallii* (T. & G.) J. T. How.

Astragalus sect. *Inflati* subsect. *Crotalariae* Jones, Rev. Astrag. 94, in clave. 1923.—Sp. typica: *A. Crotalariae* sensu Jones, non Bth. = *A. Nuttallii* (T. & G.) J. T. How.

Key to the Species of Subsect. Densifolii

1. Pod sessile on the flat or scarcely elevated (conical) receptacle, the calyx-tube early ruptured by the expanding pod; *stems* not more densely pubescent than the foliage; widespread but not insular (2)
2. Stipules (at least near the base of the main stems and often of some lateral branches also) fully amplexicaul and connate into a sheath in veneration or permanently, the sheath sometimes ruptured by expansion of the stem (especially in robust forms of var. *virgatus*); if the herbage green and subglabrous, then from San Mateo County or n.-ward; *ovules* mostly 16–36; Point Conception, Santa Barbara County, n.-ward, but only along the immediate coastline as far as San Mateo County 251. *A. Nuttallii*
2. Stipules semi- or the lowest almost fully amplexicaul but none connate, even in veneration; *herbage* green, thinly strigulose or subglabrous; *ovules* 34–55; San Luis Obispo County s.-ward, but almost always back from the ocean 252. *A. pomonensis*
1. Pod elevated on a stipelike gynophore about 2.5–6 mm. long, the calyx marcescent unruptured; *stems* cinereous-canescens on the mainland, usually more densely so than the foliage, but subglabrous on the Channel Islands (San Miguel and Santa Rosa); relatively local (mostly on serpentine), coastal San Luis Obispo and w. Santa Barbara Counties, local inland in San Benito County 253. *A. curtipes*

251. ASTRAGALUS NUTTALLII

Commonly robust and amply leafy, densely to quite thinly villous-villosulous with fine, spreading, incurved-ascending, or curly hairs up to 0.5–1.25 (1.4) mm. long, the herbage softly canescent, cinereous, or green, the leaflets equally pubescent on both sides, or thinly so above, or the vestiture reduced to a few cilia on the leaflet-margins and a line of hairs on the midrib beneath; *stems* several or numerous, 2–10 dm. long, most commonly diffuse and ascending, in exposed sites becoming prostrate and matted, when sheltered sometimes erect or assurgent, fistular when most robust, commonly glabrous and purplish at base, branched or spurred at 1–6 nodes preceding the first peduncle, floriferous upward from about 3–10 axils, the whole plant forming dense mats, low bushy, or mounded, or sometimes erect and bushy clumps; *stipules* membranous becoming papery-scarious, pallid or stramineous and sublustrous, commonly glabrous dorsally but sometimes thinly pubescent distally and nearly always ciliate, variable in size and attachment, 3–14 mm. long; *leaves* usually arcuately spreading, (2.5) 4–17 cm. long, shortly petioled or the uppermost subsessile, with (21) 23–43 crowded or mod-

erately distant, obovate, obovate-cuneate, oblong-obovate, narrowly to broadly oblong, or oblanceolate, retuse, emarginate, obtuse, or obtuse and mucronulate, penninerved, dorsally keeled, flat or loosely folded leaflets (2) 3.5–25 (28) mm. long; *peduncles* erect or incurved-ascending, at least the lowest ones usually stout, (4) 6–15 (18) cm. long, commonly longer than or equaling, rarely shorter than the leaf; *racemes* densely (15) 20–90 (125)-flowered, the flowers early nodding, the axis elongating, mostly 3–19 cm. in fruit (only some subterminal or unseasonable ones shorter or fewer-flowered); *bracts* membranous, narrowly triangular, lanceolate, or rarely ovate, 1.5–4 (5) mm. long; *pedicels* at anthesis slender, ascending or arched outward, 0.8–2.5 mm. long, in fruit thickened, mostly straight and ascending, (2.5) 3–5.5 (7) mm. long; *bracteoles* 0–2, minute or quite conspicuous when present; *calyx* (5.5) 5.8–8.2 (9) mm. long, thinly to densely villosulous or loosely strigulose with white, fuscous, or mixed hairs, the oblique disc 0.9–1.5 mm. deep, the campanulate or somewhat ovoid-campanulate, more or less tumid, membranous and pallid tube asymmetric or dorsally gibbous at base, (4) 4.3–5.7 (6) mm. long, (2.6) 3.1–4.8 mm. in diameter, the broadly subulate or triangular teeth (1.1) 1.3–3.1 mm. long, the whole becoming papery, ruptured, marcescent; *petals* greenish-white or cream-colored, the keel and sometimes the wings and banner tipped or suffused with pinkish-lilac; *banner* poorly developed relative to the wings, rhombic-spatulate or spatulate-oblanceolate, (10) 11–15 mm. long, the long-cuneate claw expanded into a short, suborbicular-flabellate, shallowly notched or emarginate blade (5.8) 6.2–9.2 mm. wide, the whole recurved through about 40°, the distal margins folded back all around; *wings* 1.1 mm. shorter to 1.4 mm. longer than the banner, (9.7) 10.5–16.5 mm. long, the claws (5.5) 6.3–9 mm., the narrowly oblong, oblong-oblanceolate, or -elliptic, obtuse, truncate, or shallowly notched, straight or gently incurved blades (5.3) 5.8–7.9 mm. long, (1.7) 2–3.2 mm. wide; *keel* (9.7) 10.5–14 mm. long, the claws (5.6) 5.8–7.1 mm., the half-obovate, obliquely obovate, or triangular blades (4.5) 4.7–6.5 mm. long, (2.2) 2.5–3.6 mm. wide, abruptly incurved through 90–100° to the broad, blunt, rarely sharply deltoid, sometimes obscurely correct apex; *anthers* (0.5) 0.55–0.8 mm. long; *pod* loosely spreading, ascending, or the lowest ones on a raceme declined, sessile, very obliquely (rarely subsymmetrically) ovoid, ovoid-ellipsoid, or half-ovoid, -obovoid, or -ovoid-ellipsoid, bladdery-inflated, (2) 2.5–5.5 (6) cm. long, 1.5–2.7 cm. in diameter, rounded or broadly obconic at base, contracted distally into a short, broadly deltoid, or longer, triangular-acuminate, erect or slightly incurved, laterally compressed beak, openly or sometimes deeply sulcate ventrally and sometimes also shallowly so dorsally, the thin, pale green or minutely purple-dotted, glabrous or thinly villosulous valves becoming papery, stramineous (often brown or purple-cheeked), lustrous, delicately cross-reticulate, not inflexed, the funicular flange narrow or subobsolete, (0.2) 0.4–1 mm. long; *seeds* brown or purplish-brown, smooth but dull, 2.2–3.8 mm. long.

The Nuttall milk-vetch, a rather coarse but nevertheless handsome species notable for the great size attained by the bladdery fruits, is the one perennial astragalus common along the immediate coast of California between Point Conception and Cape Mendocino. A robust, usually erect form is found a little inland on San Francisco peninsula, but it is otherwise a strictly maritime plant. Difficulty in naming this milk-vetch correctly is likely to arise only in San Luis Obispo and western Santa Barbara Counties, where the related *A. curtipes* comes out on rock outcrops and roadcuts to within a few hundred yards of the ocean and where *A. pomonensis* is found occasionally in sandy fields within sound of the Pacific surf. The key to the subsection should serve to distinguish these easily enough.

The species is rather uniform in its reproductive parts, but extremely polymorphic in superficial matters of vesture and growth-habit. An analysis of the variation, the results of

which are incorporated in the following key, has been published elsewhere (Barneby, 1958, pp. 133-4).

Key to the Varieties of *A. Nuttallii*

1. Pod villosulous, sometimes glabrate in age but the ovary and forming pod consistently pubescent; *ovules* 28-38, exceptionally 22; *stems* ordinarily diffuse or prostrate, assurgent in sheltered spots; herbage varying from thinly to densely villosulous, green, cinereous, or canescent, the leaflets commonly pubescent (exceptionally glabrous or glabrate) above; strictly maritime, Monterey Bay s. to Point Conception 251a. var. *Nuttallii*
1. Pod glabrous or, if the pod sparsely villosulous, the plants very robust, the stems strongly assurgent or erect; *ovules* (14) 16-21; herbage green or greenish-cinereous, the leaflets glabrous (exceptionally puberulent) above; both maritime and shortly inland, San Francisco Peninsula (and formerly on the Bay shore) and maritime n.-ward to Mendocino County 251b. var. *virgatus*

251a. *ASTRAGALUS NUTTALLII* var. *NUTTALLII*

Hairs of the herbage spreading, incurved-ascending, or curly, the longest ones up to 0.5-1.25 mm. long; *leaflets* equally pubescent on both sides or more thinly so above, rarely only ciliate on the margins and prominent midrib beneath; *stems* 2-7.5 dm. long; *stipules* either all connate, or only the lower ones of the main stems and branches fully amplexicaul, the sheath sometimes ruptured; *leaves* 2.5-15 cm. long; *racemes* (15) 20-50-flowered, the axis 3-8 (10) cm. long in fruit; *calyx* (5.6) 5.8-8.2 mm. long, the tube (4) 4.3-5.7 mm., the teeth 1.3-3 mm. long; *banner* (10.5) 11-14.5 mm. long; *wings* 11-13.7 mm. long; *keel* 10.5-12 mm. long; *pod* (2.3) 2.6-5.5 (6) cm. long, 1.7-2.7 cm. in diameter.—Collections: 45 (ii); representative: *Elmer* 3523 (CAS, NY), 4375 (CAS, NY, WTU); *Eastwood & Howell* 1903 (CAS, NY); 5974 (CAS); *Eastwood* 13,742, 13,669, 15,058 (CAS); *Barneby* 11,274 (CAS, RSA); *E. K. Balls* 16,383 (NY).

Ocean bluffs and rocky or sandy shores below 200 feet, sometimes on dunes, locally abundant on the coast of California, from Monterey Bay south to Point Conception, in Monterey, San Luis Obispo and western Santa Barbara Counties.—Map No. 110.—January to November, probably throughout the year.

ASTRAGALUS NUTTALLII (T. & G.) J. T. How. in *Leaf. West. Bot.* 5: 107. 1948, based on *Phaca Nuttallii* (Thomas Nuttall, 1786-1859) T. & G., *Fl. N. Amer.* 1: 343. 1838.—"Borders of woods near the sea, St. Barbara, California... Nuttall."—Holotypus, labeled by Nuttall: "*Phaca *inflata*. U. California," with Torrey's annotation: "non Gillies. *P. Nuttallii* T. & G.," NY (herb. Torr.)! isotypus, BM!—*Phaca inflata* Nutt. ex T. & G., l.c., in syn. (non Gillies ex H. & A., 1832). *Tragacantha Nuttallii* (T. & G.) O. Kze., *Rev. Gen.* 941. 1891.

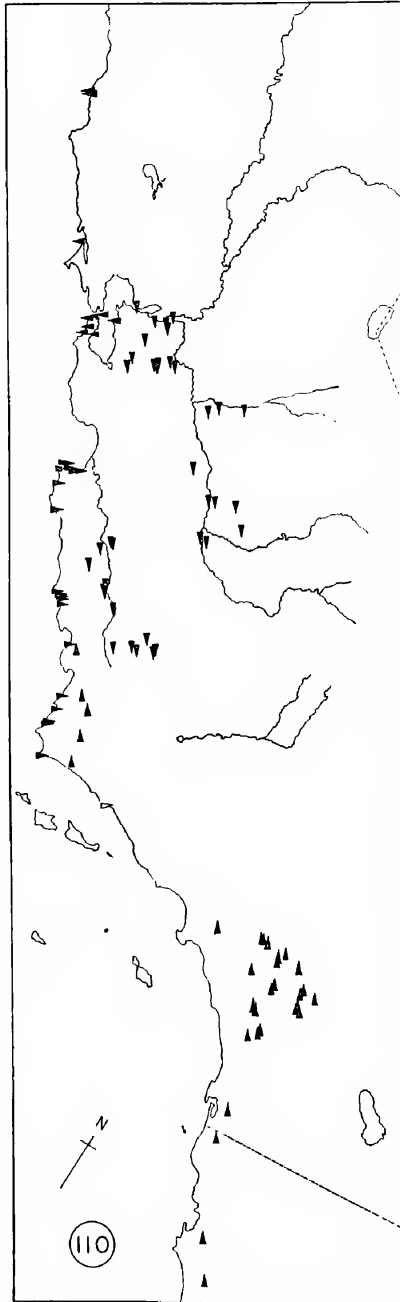
Phaca densifolia (densely leafy) Sm. in *Ree's Cyclop.* 27, *Phaca* No. 9. 1814.—"Gathered by Mr. Menzies in California."—Holotypus not located; presumed isotypi, labeled "California, Menzies," K, or "Monterey, Menzies," BM!—*A. densifolius* (Sm.) Torr. in *Pac. R. R. Rep.* 7: 10. 1856 ("*densifolia*"), quoad nom., non Lamk., 1783. *A. Menziesii* (Archibald Menzies, 1754-1842) Gray in *Proc. Amer. Acad.* 6: 217. 1894, an illegitimate substitute for the preceding, the epithet "*Nuttallii*" being passed over as though preoccupied by *A. Nuttallianus* DC., 1825. *A. Crotalariae* var. *Menziesii* (Gray) Jones, *Contrib. West. Bot.* 10: 59. 1902. *A. vestitus* var. *Menziesii* (Gray) Jones, *Rev. Astrag.* 110. 1923.

Astragalus brevidentatus (with short calyx-teeth) C. H. Wright in *Kew Bull.* 1906, p. 200.—"GALAPAGOS ISLANDS. Without collector's name, received from M. Decaisne, 1844."—Holotypus, K!—First identified as *A. Menziesii* by Johnston (in *Jour. Arn. Arb.* 19: 96. 1938): phototypus, GH!—The genus is otherwise unknown from the Galapagos.

Phaca unde (whence?—the type-locality under suspicion) Rydb. in *N. Amer. Fl.* 24: 346. 1929.—"Type collected at 'Walla Walla, Washington' (but more likely southern California), C. L. Shear 5625 (U. S. Nat. Herb...)."—Holotypus, dated July, 1899, unquestionably collected on the coast of California, US! isotypus (fragm.), NY!

At the edge of sea bluffs and on cliff ledges, where *A. Nuttallii* endures the full force of the prevailing on-shore winds, the average plant forms a mat of comparatively slender, repeatedly branching stems closely beset with shortened, softly woolly leaves, or hangs down in a dense curtain of foliage over the rock face. In sheltered spots facing inland, or in hollows

among dunes, it becomes coarse and rankly leafy, with stout fistular stems either assurgent or clambering over scrub, and the leaves are often greener though still villousulous. In the robust plant the stipular sheaths low on the stems are ruptured early, and one must turn to the lateral branches to find stipules permanently connate. Although variation in density of vesture is often correlated with stature and rankness of growth, this is not always so, for densely villosulous and glabrate states of the same growth-habit occur commonly on the coast south of Pacific Grove.



Map No. 110. The Pacific Coast, lat. $31^{\circ} 10' - 40^{\circ} 10' N.$, Mendocino County, California, south to northern Baja California. Range of *A. Nuttallii*: ♦ var. *Nuttallii* (♂ the type-locality); ♦ var. *virgatus*; of ▲ *A. pomonensis*; and of ▼ *A. asymmetricus*.

The Nuttall milk-vetch was one of three species of *Phaca* collected on the coast of California by Nuttall and attributed by Torrey and Gray to Santa Barbara. Of the three, only *P. trichopoda* has been collected there subsequently, and it is the only one of which I have seen a specimen associated with a Nuttall label actually designating Santa Barbara specifically as the place of origin. Judging from its appearance, the typus of *P. Nuttallii* might well have been collected in Monterey County. No certainly authentic holotypus of *P. densifolia* has been seen, but the traditional interpretation is fully corroborated by Smith's description of the numerous (16–20 pairs) leaflets woolly beneath and the "stipulas very broad ovate, smooth except for the point," a feature particularly characteristic of the Nuttall milk-vetch. It may have been collected while Menzies was in port at Monterey; the cited isotypi eliminate var. *virgatus* which he might have encountered at San Francisco. The typus of the absurdly named *P. unde* was certainly mislabeled; it represents a white-woolly form, but by no means an unusual one, of var. *Nuttallii*.

251b. ASTRAGALUS NUTTALLII var. VIRGATUS

Variable in habit of growth, usually coarse, erect or assurgent, the stems (4) 6–10 dm. long, sometimes relatively slender and prostrate or mounded along the immediate coast; *hairs* of the herbage loosely ascending, straight or sinuous, up to 0.5–0.95 mm. long; *leaflets* commonly glabrous, exceptionally puberulent, above, often only thinly ciliate on the margins and midrib beneath; *leaves* (4) 5.5–17 cm. long; *racemes* (25) 40–90 (125)-flowered, the axis (4.5) 6–19 cm. long in fruit; *calyx* (5.5) 6–8 (9) mm. long, its tube (4.4) 4.7–5.5 (5.9) mm., the teeth (1.1) 1.3–2.5 (3.1) mm. long; *banner* (10) 11–15 mm. long; *wings* (9.7) 10.5–16.5 mm. long; *keel* (9.7) 10.5–14 mm. long; *pod* (2) 2.5–4 cm. long, 1.5–2.5 cm. in diameter.—Collections: 25 (i); representative: *Eastwood 1575* (CAS, NY); *Kellogg & Harford 191* (CAS, NY); *A. Heller 8385* (CAS, NY); *Eastwood & Howell 6063* (CAS); *J. T. Howell 21,868, 23,159* (CAS).

Ocean bluffs, sandy fields, brushy or grassy banks, sometimes in temporarily moist, sandy bottom land, mostly below 500 feet in the coastal fog belt, formerly plentiful within and near the city of San Francisco in northern San Mateo and San Francisco Counties, but the few surviving stations threatened by urban developments, formerly on the east shore of the Bay near Alameda (*Greene in 1890*, not seen since); southeast side of Angel Island, just within Golden Gate, Marin County; also exclusively maritime, on Point Reyes Peninsula (McClure Beach), Marin County, and near Mendocino, Mendocino County.—Map No. 110.—April to July, and occasional through the year.

ASTRAGALUS NUTTALLII var. *VIRGATUS* (Gray) Barneby in *Aliso* 4: 135. 1958, based on *A. Crotalariae* var. *virgatus* (wandlike, of the racemes) Gray ap. Brew. & Wats., *Bot. Calif.* 1: 149. 1876.—"... about San Francisco, Bridges, Kellogg or Holder."—Holotypus, *Bridges 76*, GH! isotypi, NY (2 sheets); paratypes (*Kellogg & Holder*) GH, (*Kellogg in 1866*), G, P, NY!—*A. franciscanus* var. *longulus* (longish, of the racemes) Sheld. in *Minn. Bot. Stud.* 1: 135. 1898, an illegitimate substitute. *A. franciscanus* var. *virgatus* (Gray) Ckll. in *Bot. Gaz.* 26: 437. 1898. *Phaca virgata* (Gray) Rydb. in *N. Amer. Fl.* 24: 347. 1929.

Astragalus franciscanus (of San Francisco) Sheld. in *Minn. Bot. Stud.* 1: 135. 1894, based on *A. Crotalariae* sensu Gray in *Proc. Amer. Acad.* 6: 216. 1864 (non *A. Crotalariae* Bth.).—"Near San Francisco? Dr. Gibbons, received from the late Dr. Darlington, with both flowers and ripe fruit. Cocomungo, Dr. Bigelow... Valley of San Inez River, near Santa Barbara, Dr. Brewer..."—Lectotypus, *Gibbons in 1853*, GH! the paratypes (*Bigelow, Brewer*, GH!) represent *A. pomonensis* Jones.—*Phaca franciscana* (Sheld.) A. Hell., *Muhlenbergia* 2: 217. 1906. *A. vestitus* var. *franciscanus* (Sheld.) Jones, *Rev. Astrag.* 110. 1923.

The var. *virgatus* is here circumscribed to include all of several variants of the Nuttall milk-vetch known to occur on San Francisco Peninsula and on the coast from San Mateo County northward. The assemblage is somewhat inconveniently heterogeneous, since it includes a prostrate maritime phase, with exceptionally small flowers (the banner 10–11.5 mm., keel 6.7–10.5 mm. long) and stipules nearly all permanently connate, and the exceedingly robust form from more sheltered sites away from the ocean, in which all the stipular sheaths, except those on some slender branches, become early ruptured and appear only semiamplexicaul-decurrent at full anthesis. The latter is quite variable in density of pubescence, but when well

developed the hairs are of the same type as in the ordinarily gray-villous var. *Nuttallii*. The minor variant with puberulent pod, var. *virgatus* sens. strict., has been collected only about the north end of the peninsula, near Point Lobos, in the Presidio compound, and on Angel Island. I have seen one collection from the Presidio (*Nora Pettibone* in 1894, CAS) in which glabrous and puberulent pods are associated under a common label. It is impossible to separate two entities on the basis of this single character.

It is apparent from the context that when Gray proposed his var. *virgatus*, he had in mind as typical *A. Crotalariae* the species we now know as *A. pomonensis*. It was in this sense that he employed the name *A. Crotalariae* (always with reservations as to the identity of *Phaca Crotalariae* Bth.) in his Revision (1864, p. 216) except for the reference to the Gibbons plant collected doubtfully near San Francisco. It is assumed that when Sheldon based his *A. franciscanus* on *A. Crotalariae* sensu Gray, 1864, he inadvertently typified the new species by means of its epithet. It is convenient to conserve the Gibbons plant as lectotypus of *A. franciscanus*, for if applied to the Bigelow and Brewer collections from southern California, it would have to replace, most inappropriately, the later *A. pomonensis* Jones.

252. ASTRAGALUS POMONENSIS

Low, coarse, amply leafy, with a thick taproot and knotty root-crown or shortly forking caudex, the stems glabrous or nearly so, the herbage green, the leaf-rachis and lower surface, or only the midrib and margins, thinly strigulose with fine, straight, appressed or subappressed hairs up to 0.35–0.65 (0.75) mm. long; *stems* several or many, stout, striate, fistular, decumbent and ascending, (2.5) 4–8 dm. long, simple or bearing spurs or branchlets at 1–3 (6) nodes preceding the first peduncle, together forming low, leafy clumps; *stipules* broadly deltoid or ovate-acuminate, (2) 4–10 mm. long, the lowest becoming papery and fragile, decurrent around half or nearly the whole stem's circumference, free, the median and upper ones herbaceous, semiamplexicaul or less, with deflexed, dorsally glabrous, ciliate blades; *leaves* (5) 8–20 cm. long, the lowest shortly petioled, the rest sessile or nearly so, with 25–41 narrowly oblong or ovate-cuneate, or rhombic-ovate, truncate, emarginate and mucronulate, or subacute, flat, commonly penninerved leaflets (0.3) 0.6–3 (3.7) cm. long; *peduncles* stout, erect or incurved-ascending, mostly decumbent in age, 5.5–14 cm. long, shorter than the leaf; *racemes* (10) 20–45-flowered, dense at early anthesis, becoming looser or interrupted in age, the flowers early horizontal or declined, the axis more or less elongating, 3.5–9 cm. long in fruit, the fruits subcontiguous, densely racemose; *bracts* membranous, pallid, ovate-triangular or lanceolate, 1.5–3.5 mm. long; *pedicels* ascending or a little arched outward, at anthesis 0.6–1.5 mm., in fruit thickened, persistent, 1.5–3.5 mm. long; *bracteoles* 0; *calyx* 5–7.2 (7.7) mm. long, strigulose with white, black, or mixed black and white hairs, the oblique disc 0.9–1.3 mm. deep, the broadly campanulate tube obliquely truncate or subgibbous dorsally at base, 3.5–4.8 (5) mm. long, 3–4.4 mm. in diameter, the subulate or triangular-subulate teeth (1) 1.3–2.6 (3) mm. long, the dorsal one either longest or shortest, the orifice oblique, the whole becoming papery, ruptured, marcescent; *petals* greenish-white or ochroleucous, immaculate; *banner* gently recurved through about 40°, obovate-cuneate, broadly oblanceolate, or rhombic-flabellate, shallowly notched, 11.1–15.3 mm. long, 5.7–8 mm. wide; *wings* as long or up to 1 mm. shorter, 11–15 mm. long, the claws 5–6.6 (6.9) mm., the narrowly oblong-oblanceolate, obtuse, truncate, or shallowly emarginate, straight blades 6.2–9.5 mm. long, 2.2–3 mm. wide; *keel* 9.4–13.2 mm. long, the claws 5.1–6.6 (6.9) mm., the half-obovate blades (4.6) 4.9–6.3 (6.9) mm. long, 2.3–2.9 mm. wide, abruptly incurved through 85–95° to the bluntly deltoid apex; *anthers* 0.5–0.7 mm. long; *pod* horizontal or ascending at a wide angle, sessile, readily deciduous, obliquely ovoid or half-ovoid, bladderly-inflated, (1.8) 2.3–4.5 (5) cm. long, (1) 1.2–2 (or when pressed seemingly up to 2.3) cm. in diameter, rounded or broadly obconic at base, contracted distally into a short, deltoid,

laterally compressed, slightly incurved beak, openly sulcate along the straight or slightly convex ventral suture, and obscurely so along the gibbous-convex dorsal one, the thin, pale green or purplish, sparsely strigulose or ultimately glabrate valves becoming papery, stramineous, sublustrous, semitransparent, delicately reticulate, not inflexed, the funicular flange 0.5–1.5 mm. wide; *dehiscence* apical, after falling; *ovules* 34–55 (commonly ± 40); *seeds* orange-brown or olivaceous, $\pm$ pitted, dull, (2.3) 2.6–3.5 mm. long.—Collections: 45 (ii); representative: *Twisselmann 2891* (CAS, RSA); *Jones* (from Gaviota Canyon) in 1926 (CAS, NY, US); *Wheeler 2502* (CAS, SMU, RSA, WS); *C. B. Wolf 6298* (CAS, TEX, WS); *Clokey & Templeton 4634* (CAS, NY, WS); *C. L. Hitchcock 6007* (NY, WS); *Wiggins 6169* (CAS).

Grassy or brushy hillsides, openings in chaparral, fallow fields and valley floors, sometimes a weed in orchards, common and locally plentiful below 2300 feet in the interior valleys of southern California (especially San Bernardino and San Jacinto Valleys) and extending to the desert edge in Morongo Pass, south in scattered stations to extreme northwestern Baja California, and north, in sandy fields or sometimes on stabilized dunes near the coast to the lower Sisquoc and Cuyama Rivers in Santa Barbara County and Morro Bay in San Luis Obispo County.—Map No. 110.—March to May, sometimes later in orchards.

ASTRAGALUS POMONENSIS (of Pomona, California) Jones, Contrib. West. Bot. 10: 59. 1902 ("Pomonensis").—"Common on the tableland above Fallbrook Calif., to Los Angeles... the type is from my collection of 1882."—Lectotypus, *Jones 3166*, collected at San Jacinto, Riverside County, April 24, 1882, POM (2 sheets)! isotypi, CAS, DS, NY (2 sheets) UTC! paratypes, *Jones 3166* (in part) from Temecula, Riverside County, POM (2 sheets), DS!—*Phaca pomonensis* (Jones) Rydb. in N. Amer. Fl. 24: 346. 1929.

The Pomona milk-vetch was first discovered by Bigelow in 1854 while at Cucamonga in San Bernardino Valley with Lieut. Whipple's survey party, and shortly thereafter by Antisell, on Parke's Expedition, at San Gabriel. The Bigelow collection was misidentified by Torrey as *Phaca densifolia* and furnished the occasion for the new combination *A. densifolius* (Sm.) Torr., a nomenclatural and taxonomic synonym of *A. Nuttallii*. Bigelow's plant was afterward associated by Gray (1864, p. 216) with another example of *A. pomonensis* collected in Santa Barbara County by Brewer and referred, with an extraneous element of *A. Nuttallii* var. *virgatus* from San Francisco, to *A. Crotalariae* sensu Gray, which is not, as Gray already suspected, the original *Phaca Crotalariae* Bth. It is clear enough from the early history of *A. pomonensis* that a close relationship between it and *A. Nuttallii* was perceived from the first, and it has since gone unchallenged. In practice *A. pomonensis* may be distinguished from the forms of *A. Nuttallii* that occur on the coast in the same latitudes in Santa Barbara and San Luis Obispo Counties by its green, thinly strigulose or glabrate (and not softly villous) herbage; while it differs from the glabrate but allopatric *A. Nuttallii* var. *virgatus* in its truly free stipules and numerous (34–55, not 14–21) ovules. The species is anomalous in its section because of the free stipules; in this character, as also in the form and texture of the pod, it simulates *A. (Inflati) Douglasii* and is often mistaken for it. The superficial similarity is so marked that I have introduced *A. pomonensis* into the key to sect. *Inflati* in the hope of forestalling confusion in future; but fuller contrasts between the two species may appropriately be presented here:

1. Leaflets 25–41; *racemes* dense, sometimes loosening in age; *claws* of the wings and keel 5–7 mm. long; *blades* of the keel shorter than or equaling the claws, half-obovate, bluntly deltoid at apex; *ovules* 34–55 (averaging ± 40). — *A. pomonensis*
1. Leaflets 11–25; *racemes* early loosening or loose from the first; *claws* of the wings and keel 2.2–4.9 mm. long; *blades* of the keel mostly 4.6–6 mm. long, longer than the claws, lunately triangular or lance-elliptic, narrowly deltoid to triangular at apex; *ovules* (in pertinent cases) 42–70 (averaging 50–55) — *A. Douglasii*

In southern California *A. Douglasii* is represented by its var. *Parishii*, which may often be recognized by its strongly recurved banner only 8–12 (not 11–15) mm. long. North of Los Angeles *A. pomonensis* is found at lower elevations and farther west than var. *Douglasii*.

The distribution of the Pomona milk-vetch, a conspicuous, coarsely leafy astragalus which has no claim to beauty except for the large, eventually lustrous fruits of parchment texture, is

rather curious. Its center of abundance lies well back from the coast in southwestern San Bernardino and western Riverside Counties, where it is the commonest perennial astragalus on low grassy hills and valley bottoms. In San Diego County and adjoining Baja California, it is associated with a flora of pronounced oceanic type, although it does not extend onto the coastal bluffs or beaches. Surprisingly there is no record of *A. pomonensis* from either Los Angeles or Ventura Counties. Where it reappears in western Santa Barbara and adjoining San Luis Obispo Counties, the species is comparatively rare and again suboceanic, although not truly maritime. The Pomona milk-vetch is subject to little variation.

253. *ASTRAGALUS CURTIPES*

Perennial, of moderate stature, with a thick taproot and stems at length somewhat indurated at base, strigulose and sometimes also minutely tomentulose with appressed or narrowly ascending, short and curly together with some longer, straight hairs up to 0.4–0.8 mm. long, the stems commonly densely so, cinereous or canescent but sometimes green, the herbage greenish-cinereous, the leaflets glabrous above; *stems* several, erect and ascending in clumps, 2.5–4 dm. long, shortly branched or spurred at most of the lower nodes, floriferous from 2–6 nodes above the middle, the inflorescences usually projected well above the leafy stems; *stipules* papery-membranous, pallid or stramineous, 2–12 mm. long, all amplexicaul and connate through more than half their length into an appressed, bidentate sheath, this sometimes ruptured by expansion of the stems, the uppermost ones sometimes free or nearly so to the base, all thinly pubescent dorsally; *leaves* (4) 5–16 cm. long, petioled or the uppermost only quite shortly so or subsessile, with 25–39 linear-oblong to narrowly obovate, obtuse or truncate-emarginate, flat or loosely folded leaflets (2) 5–25 mm. long; *peduncles* erect, slender but rather stiff, (5.5) 7–25 cm. long, usually surpassing (or on the islands shorter than) the leaf; *racemes* rather densely 15–35-flowered, the flowers early spreading and then declined, the axis a little elongating, 2–11 cm. long in fruit; *bracts* scarious, lanceolate or triangular-acuminate, 1.4–3.7 mm. long; *pedicels* at anthesis arched outward, 1–2.8 mm. long, in fruit somewhat thickened, straight, erect or narrowly ascending, 2.5–6 mm. long; *bracteoles* 0, or minute and scale-like; *calyx* 6–8.6 mm. long, rather densely strigulose with mixed black and white or all black hairs, the slightly to strongly oblique disc 0.8–1.5 mm. deep, the campanulate tube (3.7) 4–5 mm. long, (2.8) 3–4 mm. in diameter, the subulate or lanceolate teeth (1.5) 1.8–3.6 mm. long, the whole becoming papery, marcescent unruptured; *petals* creamy-white, concolorous, or the keel faintly lilac-tipped; *banner* gently recurved (at a point remote from the orifice of the calyx) through about 50°, rhombic-spatulate, shallowly emarginate or subentire, 13–16 mm. long, 6–8.8 mm. wide; *wings* as long or a little shorter, 12.4–15.3 mm. long, the claws 6–7.7 mm., the narrowly oblong-oblancheolate, obtuse or obscurely emarginate, often undulate-erose blades 7.4–9.4 mm. long, (2.1) 2.4–3.1 mm. wide, more or less incurved in the distal half; *keel* 10.7–12.7 mm. long, the claws 5.9–7.5 mm., the half obovate blades (4.8) 5–6.5 mm. long, 2.8–3.5 mm. wide, abruptly incurved through 85–95° to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.5–0.8 mm. long; *pod* ascending, loosely spreading, rarely declined, sessile on and disjointing from a stiff, stipelike gynophore 2.3–5.5 (6) mm. long, the body obliquely obovoid or half-obovoid-ellipsoid, bladdery-inflated, 2.3–3.6 cm. long, 1.2–1.8 (2) cm. in diameter, broadly to narrowly obconic at base, contracted distally into a short, broadly deltoid, laterally flattened, erect or slightly to strongly incurved beak, the sutures both filiform, the ventral one straight or slightly convexly or concavely arcuate, the dorsal one strongly gibbous-convex, the thin, pale green, sparsely strigulose valves becoming papery-membranous, stramineous, lustrous, subdiaphanous, delicately cross-reticulate, not inflexed, the funicular flange 0 or not over 0.3 mm. wide; *dehiscence* apical, after falling; *ovules*

(26) 28–37; seeds brown, smooth but dull, 2.2–3.3 mm. long.—Collections: 28 (iii); representative: *Eastwood 2216* (CAS), *14,318* (CAS); *L. S. Rose 36,084* (CAS, NY, WS); *Barneby 11,277, 11,281* (CAS, NY, RSA); *Eggleston 19,588* (CAS, NY).

Grassy and brushy hillsides, rocky bluffs, and fallow fields near the coast, 50–450 feet, commonly associated with outcrops of serpentine or metamorphic bedrock, locally plentiful in scattered stations from the mouth of San Simeon Creek, San Luis Obispo County, south to near Point Arguello, Santa Barbara County; also (in slightly different form discussed below) on San Miguel and Santa Rosa Islands; a poorly known but probably distinct form isolated inland in San Benito County.—Map No. 111.—(January) February to June, sometimes again in fall.

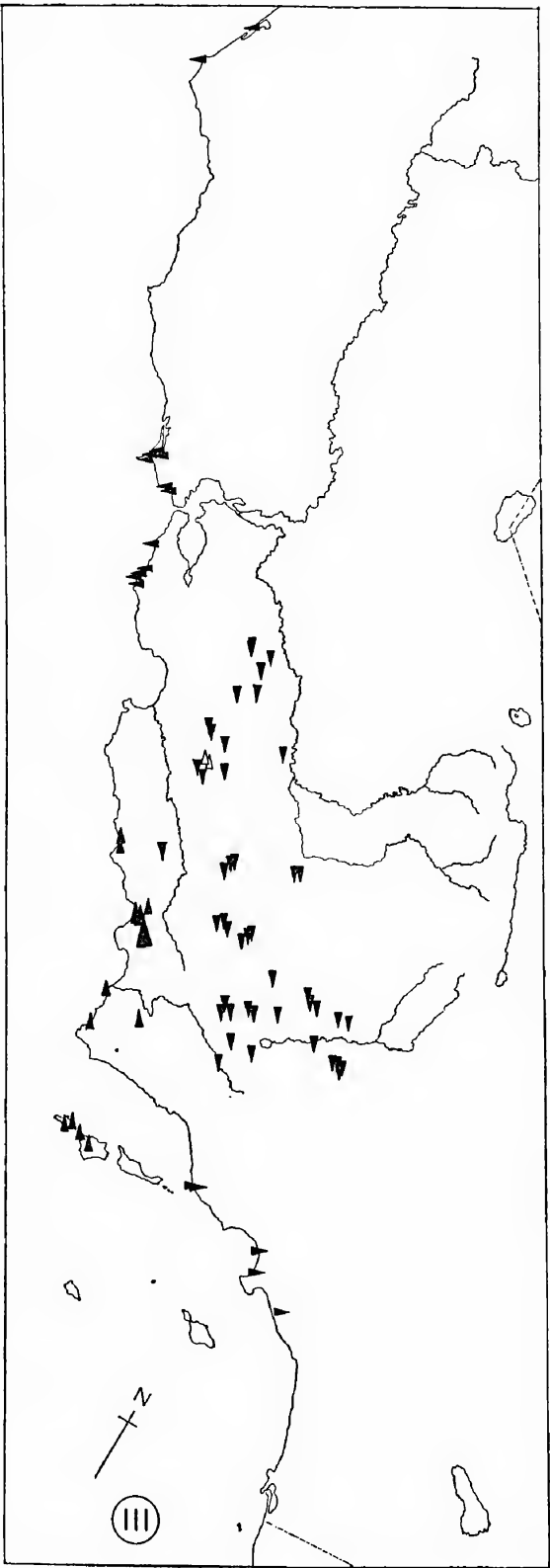
ASTRAGALUS CURTIPTES (with short stipe or gynophore) Gray in Proc. Amer. Acad. 6: 217. 1864.—“San Luis Obispo, California, on the side of a dry hill, April 13th. Dr. Brewer.”—Holotypus, *Brewer 460*, GH! isotypi, CAS (dated “April 14”), US (dated “April, 1861”)!—*Tragacantha curtipes* (Gray) O. Kze., Rev. Gen. 944. 1891. *A. leucopsis* var. *curtipes* (Gray) Jones, Contrib. West. Bot. 10: 62. 1902. *Phaca curtipes* (Gray) Rydb. in N. Amer. Fl. 24: 337. 1929.

Astragalus leucopsis var. *brachypus* (with short stipe) Greene in Pittonia 1: 33. 1887.—“Island of San Miguel: quite common, particularly on the southern and eastern parts of the island.”—Holotypus, collected by Greene in September, 1886, ND (3 sheets); isotypus, PH!—*A. leucopsis* var. *curtus* (short) Sheld. in Minn. Bot. Stud. 1: 134. 1894, a superfluous substitute.

The Morro milk-vetch, *A. curtipes*, is nearly related to *A. Nuttallii* with which it agrees in most technical respects other than the elevation of the pod on a gynophore which simulates the true stipe of sect. *Trichopodi*. It is a tall, graceful astragalus, of more slender growth than the rank, erect phases of *A. Nuttallii* var. *virgatus* found farther north and is much less copiously and softly villous than the prostrate var. *Nuttallii* native to coastal bluffs in the same latitudes. Superficially it resembles some forms of *A. trichopodus* var. *lonchus* (= *A. leucopsis*). Jones at first subordinated the species to *A. leucopsis* as a variety and later concluded that it represented no more than “a freak of *A. leucopsis* with connate stipules.” No one who has seen the colonies of *A. curtipes*, uniform in all critical characters, on the coastal hills of San Luis Obispo County, or who has learned to discriminate between a true stipe and a stipe-like gynophore, will care to endorse this view. The Morro milk-vetch and *A. trichopodus* var. *lonchus* are apparently vicariant and allopatric; the latter extends north to the Channel Islands from its main area much farther south along the coast, where it is known only on Santa Cruz and Anacapa, while *A. curtipes* extends south only to Santa Rosa and San Miguel. The possible significance of the provocative similarity, combined with morphologically profound differences in the fruit of these two coastal milk-vetches, is discussed further in the introduction to sect. *Densifolii*.

The description of the Morro milk-vetch, prepared from samples of the populations found on the islands and the seaward slope of the outer Coast Ranges, takes no account of the evidently related but imperfectly known astragalus from San Benito County, probably a distinct entity. The mainland plant nearly always has stems much more densely pubescent than the leaves—the canescent vesture of the internodes contrasting with the scarious, thinly pubescent stipules and green or greenish-cinereous foliage—peduncles well surpassing the leaves, and whitish, concolorous petals. On the islands the common phase is more thinly pubescent throughout, with dorsally glabrous or glabrate stipules, green stems, peduncles about equaling the leaf, and a lilac keel-tip. The vesture of the insular plant lacks the shorter, curly type of hair nearly always present in continental *A. curtipes*. The collections cited above are of the strictly typical form; the following represent the island variant which seems scarcely to deserve taxonomic status: *Munz & Crow 11,749, 11,828*; *Munz 11,745* (all POM); and the typus of *A. leucopsis* var. *brachypus*, which would furnish, if needed, a varietal epithet.

The form or relative of *A. curtipes* already mentioned as isolated in the interior is known to me from two fruiting collections from San Benito County (San Benito, *J. T. Howell 11,075*; Buena Vista Ranch, 4 miles southwest of Reinoso Peak, 1600 feet, *Gregory S. Lyon 1862*, both CAS) which differ collectively from *A. curtipes* in having enormous pods, 4.5–7 cm. long, 2.5–4 cm. in diameter. The leaflets vary from glabrous to pubescent above. The characters of this form have not been introduced into the description of *A. curtipes*, pending discovery of the flowers.



The typical, coastal form of the Morro milk-vetch was collected first in 1832 by the Irish botanist Thomas Coulter (*Nos.* 433, 434, K), but his material was passed over by Bentham as representing the then little-known *A. asymmetricus*.

LXVII (ii). Subsectio PYCNOSTACHYI

Plants pilose-tomentulose; *stems* erect; otherwise as given in the subsectional key.—Sp. 1, of coastal California (Humboldt to Orange County).

ASTRAGALUS sect. DENSIFOLII subsect. PYCNOSTACHYI, (Rydb.), stat. nov., based on *Phaca* subgen. *Chartocystis* sect. *Pycnostachyae* Rydb. in N. Amer. Fl. 24: 357. 1929, pro parte, exclus. *A. Hornii*.—Sp. typica: *P. pycnostachya* (Gray) Rydb. = *A. pycnostachyus* Gray.

The brine milk-vetch, *A. pycnostachyus*, is highly modified morphologically and uniquely adapted to the environment of coastal seeps and marshland. Gray thought the species wholly peculiar, but it was subsequently associated by Jones (1923, p. 103) and by Rydberg (1929, l.c.) with *A. Hornii*, with which it has in common a dense inflorescence of rather small flowers. The latter resembles *A. pycnostachyus* further in its late season of bloom, and one form of it even comes out to alkaline flats near the ocean in Baja California; but it is annual, has greatly inflated pods and free stipules, and the relationship, if such exists, is certainly remote. On the other hand, *A. pycnostachyus* resembles *A. Nuttallii* in many features; the most important are the type of vesture, the large, scarious, dorsally subglabrous stipules, of which at least the lowest are connate-sheathing, and the orientation and proportions of the flower. The small, laterally flattened pod with its salient sutures differs so greatly from the immense bladders of *A. Nuttallii* that the two species are here referred to separate subsections. The likeness to *A. Brauntoni* emphasized by Jepson (1936, p. 364) is in my opinion a purely superficial one.

254. ASTRAGALUS PYCNOSTACHYUS

Stout, leafy perennial, with a thick taproot, pilose-tomentulose throughout with fine, short, sinuous or curly together with longer, straighter, ascending hairs up to 0.6–1.2 (1.7) mm. long, the stems thinly so (often glabrous basally), brown or purple-tinged, the herbage cinereous, canescent, or silvery-white, the leaflets equally pubescent on both sides, the inflorescence commonly black-hairy; *stipules* papery-membranous becoming scarious, fragile, and often irregularly deciduous in age, 3–12 mm. long, deltoid or triangular-acuminate or -caudate from a broad, amplexicaul or semiamplexicaul base, the lowest of the main stem and (commonly) of the branchlets or spurs connate at base or through half their length into a bidentate sheath (often ruptured by expansion of the stem), the median and upper ones mostly semiamplexicaul, free, all glabrous or very thinly pubescent dorsally; *stems* several or many, erect and ascending in clumps from a superficial or shallowly buried root-crown, 4–9 dm. long, striate and fistular, branched or spurred at several or almost all nodes preceding the first of the 3–11 peduncles, floriferous subterminally or from well above the middle; *leaves* 3–13 (15) cm. long, all but the lowest sessile or nearly so, with (23) 27–41 crowded, narrowly oblong, oblong, oblong-elliptic, or linear-lanceolate, obtuse or emarginate but apiculate, flat or loosely folded leaflets (0.2) 0.5–3 cm. long, all dorsally carinate by the midrib and diminishing upward along the rachis; *peduncles* erect or incurved-ascending, 2–9 cm. long, shorter than the leaf; *racemes* densely many-flowered, the flowers at full anthesis declined and retrorsely imbricated in cylindro-oblong, spikelike heads 2–7 (9) cm. long, 1.8–2.3 cm. in diameter, the axis little or not elongating, 2.5–8 (9.5) cm. long in fruit; *bracts* papery-membranous, narrowly lance-acuminate or linear-caudate, (1.2) 1.6–4 mm. long, commonly reflexed in fruit; *pedicels* at anthesis 0.7–1.2 mm. long, early arched outward and downward, in fruit scarcely thickened, 1–1.8 mm. long, persistent or perhaps very

Map No. 111. Coast (southward from central Humboldt County) and Great Valley of California. Range of *A. pycnostachyus*: ♦ var. *pycnostachyus*; and ♦ var. *lanosissimus*; of ▲ *A. curtipes* (▲ a large-fruited variant mentioned in the text); and of ▼ *A. oxyphysus*.

tardily disjointing; *bracteoles* 0; *calyx* 5.4–7.8 mm. long, villosulous with mixed black or fuscous and white hairs, the slightly oblique disc (0.6) 0.8–1.2 mm. deep, the ovoid-campanulate tube 3.7–5.2 mm. long, 2.7–3.9 mm. in diameter, the teeth 1.3–3 mm. long, the orifice more or less oblique, the whole becoming papery, ruptured, marcescent; *petals* greenish-white or cream-colored, poorly or irregularly graduated, the wings 0.6 mm. shorter to 0.3 mm. longer than the banner, the keel 0–1.1 mm. shorter than the wings; *banner* gently recurved through about 35° (or further in withering), spatulate or rhombic-spatulate, shallowly notched or subentire, 7–10 mm. long, 4–5.2 mm. wide; *wings* 7.3–10.3 mm. long, the claws 3.5–5.5 mm., the obovate or broadly oblanceolate, obtuse or (when broad) obliquely emarginate, slightly incurved blades 3.4–5.4 mm. long, 1.8–3 mm. wide; *keel* 7.1–9.1 mm. long, the claws 4–5.5 mm., the half-obovate or obliquely oblong blades 3.1–4.2 mm. long, 1.7–2.5 mm. wide, abruptly incurved through 95–100° to the bluntly deltoid, obscurely porrect apex; *anthers* 0.45–0.6 mm. long; *pod* deflexed or declined, sessile, long-persistent on the receptacle, ovoid-lenticular, a little inflated but hardly bladdery, the body 6–11 mm. long, 3.5–6 mm. in diameter, broadly rounded at base, triangular-acute at apex and beaked by the incurved, persistent style, a little compressed laterally, bicarinate by the salient sutures (the ventral one thicker and more prominent), the lateral faces distended and convexly rounded toward the dorsal suture, the thin, green, glabrous or puberulent valves becoming papery, stramineous or brownish, somewhat lustrous, not inflexed, the funicular flange 0; *dehiscence* very tardy, apical; *ovules* (2) 3–12; *seeds* brown or greenish-brown, smooth, dull or sublustrous, 2–2.8 mm. long.

Key to the Varieties of *A. pycnostachyus*

1. Peduncles (3) 4–10 cm. long; *calyx-tube* 3.7–5.2 mm. long, the teeth subulate, 1.7–3 mm. long; *pod* 6–9 (10) mm. long; *ovules* (2) 3–5, commonly 4; Humboldt to San Mateo County 254a. var. *pycnostachyus*
1. Peduncles 2–4 cm. long; *calyx-tube* 3–3.5 mm. long, the teeth broader and shorter, 1.2–1.5 mm. long; *pod* 8–11 mm. long; *ovules* 8–12; Ventura to Orange County 254b. var. *lanosissimus*

254a. *ASTRAGALUS PYCNOSTACHYUS* var. *PYCNOSTACHYUS*

Herbage cinereous or subcanescent, rarely white-tomentulose; *leaflets* (23) 27–41, narrowly oblong, oblong-elliptic, or linear-lanceolate, flat or loosely folded, (0.2) 0.5–3 cm. long; *pod* glabrous.—Collections: 21(i); representative: *C. F. Baker* 1744 (CAS, NY, POM, WS); *Elmer* 4617 (CAS, DS, NY, WS); *J. T. Howell* 21,253, 21,433 (CAS, RSA); *J. H. Thomas* 7372 (DS).

Salt marshes within reach of high tide or protected by barrier beaches, more rarely near seeps on sandy ocean bluffs, or (according to Jepson) in springy spots along creeks opening to the ocean, 0–100 feet, local but forming colonies, along the immediate coastline of central and northwestern California, in Marin and San Mateo Counties, and apparently disjunctly in central Humboldt County (Samoa; Cape Mendocino).—Map No. 111.—June to September.

ASTRAGALUS PYCNOSTACHYUS (with fat flower-spikes) Gray in Proc. Amer. Acad. 6: 526. 1865 ("*pycnostachius*").—"Baulinas [now Bolinas] Bay, in salt marshes within reach of tide, H. N. Bolander."—Holotypus, *Bolander* 2513, collected in 1863, GH! isotypus, US!—*Tragacantha pycnostachya* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca pycnostachya* (Gray) Rydb. in N. Amer. Fl. 24: 357. 1929.

In April and May, when the ocean bluffs of central California are gay with flowers and the baggy fruits of the related *A. Nuttallii* are already fully formed, the brine milk-vetch, var. *pycnostachyus*, down in the neighboring marshes, is scarcely yet in bud. From midsummer onwards it is a handsome plant, notable for its stout, hollow, reddish stems, which contrast with the recurving, softly pubescent, grayish or rarely white-woolly leaves, and for its dense spike-

like racemes of backwardly imbricated flowers. The fruits, forming in July and later, ripen slowly; I have seen no convincing example of a natural fall or dehiscence. Both, if they occur at all, are tardy, as often happens with small pods of light weight and simple compression.

254b. *ASTRAGALUS PYCNOSTACHYUS* var. *LANOSISSIMUS*

Habit of the species, but the herbage consistently white-lanate, almost silvery when young; *leaflets* 27–39, oblong, flat, (3) 5–20 mm. long; *pod* usually thinly strigulose, sometimes glabrous.—Collections: 8 (o); representative: *Hasse* in 1888 (NY, OB); *Braunton* 682 (DS, NY); *G. B. Grant* 6317 (DS, MO, UC, WIS); *J. B. Davy* 7810 (UC).

Habitat of var. *pycnostachyus*, now very rare or extinct, known only from three or four stations along the coast of southern California, from near Point Hueneme, southern Ventura County, south to the now drained Ballona Marshes in Los Angeles and probably extreme northern Orange Counties.—Map No. 111—July to October.

ASTRAGALUS PYCNOSTACHYUS var. *LANOSISSIMUS* (Rydb.) Munz & McBurney ex Munz in Bull. S. Calif. Acad. Sci. 31: 66. 1932, based on *Phaca lanosissima* (very woolly) Rydb. in N. Amer. Fl. 24: 357. 1929.—“Type collected at La Bolsa, Los Angeles County, California, in October, 1882, S. B. & W. F. Parish 1117 (Morong Herbarium).”—Holotypus, NY!—Parish specimens, some attributed to S. B. Parish alone, are variously labeled: “La Bolsa, October, 1881” (PH); without locality, “October, 1882” (ND); “No. 1117, Santa Monica” (UC); “No. 1117, Ballona Rancho, October, 1881” (DS, US); “meadow near the seashore, Santa Monica, October, 1882” (WS). Apparently there were two collections, one from Santa Monica in 1882 (the typus; probably represented also at ND, UC, WS), and another from La Bolsa = Ballona in 1881 (at PH, US, and in herb. Parish, DS), later mixed and distributed in part under the same serial number.

The southern form of the brine milk-vetch, var. *lanosissimus*, differed from var. *pycnostachyus* chiefly in the short calyx-teeth, short peduncles, and slightly longer pod enclosing more numerous ovules and seeds. The dense lanate vesture of the leaves was also characteristic, but a few almost equally white forms of var. *pycnostachyus* have been collected. It is appropriate to speak of var. *lanosissimus* in the past tense, for it is in all probability extinct, like *Potentilla multifida* Lehm., its former associate in the Ballona Marshes. It has not been collected to my knowledge in the past fifty years, and my own attempts to see it during several years' residence in the Los Angeles area were unavailing. Possibly it may still exist on the Government reservations near Point Hueneme, but there is no hope of its survival near Santa Monica or southward.

LXVII (iii). Subsectio *OXYPHYSI*

Stems erect and ascending in clumps; *vesture* villosulous or villous-tomentulose; differential characters given in the sectional key.—Sp. 1, xerophyte, of the arid interior Coast Ranges of central California from Stanislaus south to Santa Barbara County, extending east around the head of San Joaquin Valley just into the southern Sierra foothills.

ASTRAGALUS sect. *DENSIFOLII* subsect. *OXYPHYSI* (Jones), comb. nov., based on *Astragalus* sect. *Inflati* subsect. *Oxyphysi* Jones, Rev. Astrag. 96, in clave. 1923.—Sp. unica: *A. oxyphysus* Gray.—*Phaca* subgen. *Podocystis* sect. *Oxyphysae* (Jones) Rydb. in N. Amer. Fl. 24: 335. 1929.

The unique character of *A. oxyphysus* was appreciated by Jones and by Rydberg, each of whom placed the species in a group apart. The pod is a remarkable one, greatly inflated in that the cavity is very much larger than required to accommodate the seeds, but at the same time strongly flattened laterally and consequently not really balloon-like. The pod resembles that of *A. pycnostachyus* on a much larger scale, but is elevated on a stout, densely villosulous gynophore. The pubescence of the gynophore is a peculiar feature, the only instance in the genus, known to me, of hairs borne on the receptacle.

255. *ASTRAGALUS OXYPHYSUS*

Tall, robust perennial, with taproot and stems at length $\pm$ indurated at base, villosulous nearly throughout with fine, ascending, incurved, wavy, or curly hairs up to 0.6–0.95 mm. long often mixed with a few longer, straighter ones up to 1–1.6

mm. long, the stems and those leaves developing before and with the flowers greenish-cinereous, the leaflets sometimes glabrescent above, those leaves developing after the flowers and those of basal innovations produced late in the season more densely pubescent, commonly white-tomentose; *stems* several or numerous, erect and ascending in bushy clumps, stout, striate, fistular at base, (1.5) 3–8 dm. long, bearing a slender branch or spur at 1–several nodes preceding the first of some 3–5 (6) peduncles, rarely a spur and peduncle together in the same axil; *stipules* submembranous becoming papery-scarious and fragile, the lowest often early deciduous, deltoid, triangular- or lance-acuminate, (3) 4–12 mm. long, the lowermost ones amplexicaul and connate (at least in veneration) through $\pm$ half their length into a bidentate sheath (but this often ruptured by the expanding stem), the median and upper ones embracing $\pm$ half the stem, all thinly, or the upper ones densely pubescent dorsally; *leaves* (4.5) 7–17 cm. long, all shortly petioled or the upper ones subsessile, with (11) 17–29 (31) broadly to narrowly lance- or oblong-elliptic, or oblong-obovate, obtuse, subacute, truncate and mucronulate, or (in some lower leaves) retuse, flat leaflets (4) 7–32 mm. long; *peduncles* stout, erect, (4) 7–17 cm. long, mostly as long or longer than the leaf; *racemes* 20–60 (65)-flowered, loose or early becoming so, the flowers at first ascending, loosely declined or nodding in age, the axis elongating, (4.5) 6–22 (25) cm. long in fruit; *bracts* membranous, lanceolate or lance-ovate, 2–3.5 mm. long; *pedicels* ascending, straight or arched outward, at anthesis 1.2–2 mm., in fruit thickened, persistent, 2–4 mm. long; *bracteoles* 0–2; *calyx* 8.7–10.3 mm. long, villousulous with mixed white and fuscous or black hairs, the slightly or strongly oblique disc 1.3–2 mm. deep, the cylindric or deeply campanulate tube 5.9–8.4 mm. long, 2.8–3.8 mm. in diameter, the subulate or triangular-subulate teeth 1.6–3.7 mm. long, the dorsal one often shorter, rarely longer than the rest, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* pale cream-color or almost white, immaculate; *banner* gently recurved through $\pm$ 50° (or further in withering), oblanceolate, rhombic- or elliptic-oblanceolate, 15.3–18 (19) mm. long, 5–8.2 mm. wide, shallowly notched or subentire at apex; *wings* 14.6–17.1 mm. long, the claws 7.4–8.9 mm., the narrowly oblong-oblanceolate, obliquely emarginate or (when narrow) entire and obtuse, slightly incurved blades 8–9.8 mm. long, 2–3.2 mm. wide; *keel* 13.1–14.7 mm. long, the claws 7.6–9.1 mm., the lunately half-elliptic blades 5.9–6.4 mm. long, 2.4–3 mm. wide, gently incurved through 70–90° to the bluntly triangular apex; *anthers* 0.55–0.8 mm. long; *pod* spreading or loosely pendulous, sessile but elevated on and readily dis-jointing from a slender, densely villousulous, outwardly arched, stipelike gynophore 3–11 mm. long, the body obliquely elliptic, half-elliptic, or rhombic-elliptic in profile, (2.1) 2.5–4.5 cm. long, (6) 8–15.5 mm. in diameter, downwardly acuminate from above the middle, more shortly acuminate or triangular distally, bladdery-inflated but also laterally compressed, bicarinate by the filiform, salient sutures, the thin, pale green, sparsely strigulose (or in age glabrate) valves becoming papery, stramineous, lustrous, semitransparent, delicately cross-reticulate, not inflexed, the funicular flange obscure, not over 0.3 mm. wide; *dehiscence* apical, after falling; *ovules* 11–18; *seeds* brown, sometimes purple-speckled, smooth or sparsely pitted, dull, 3–3.9 mm. long.—Collections: 47 (vii); representative: *L. S. Rose* 49,140 (CAS, SMU, WIS, approximate topotypi); *Eastwood* 6907 (CAS, NY); *Ferris & Bacigalupi* 10,354 (NY, TEX, WS); *C. B. Wolf* 4577 (CAS, POM, TEX, WS); *Eastwood & Howell* 4080 (CAS, NY); *Barneby* 11,368 (CAS, RSA).

Rolling plains, grassy hillsides and canyon banks, mostly in arid grassland, 250–2200 feet, extending rarely up into the digger pine belt at 3200 feet, common

and sometimes forming extensive and conspicuous colonies, inner South Coast Ranges and adjacent Great Valley of California, from the Mt. Hamilton Range, Stanislaus County, south to the upper Cuyama Valley and the foothills of the Tehachapi Mountains and extreme southern Sierra Nevada in Santa Barbara and Kern Counties; one station on the east slope of the Santa Lucia Mountains in northern San Luis Obispo County.—Map No. 111.—March to June.

ASTRAGALUS OXYPHYSUS (with pointed bladders, of the fruit) Gray in Proc. Amer. Acad. 6: 218. 1864.—“California, Arroyo del Puerto, in the Mt. Diablo range, on dry hills, June 11, in flower and fruit, Dr. Brewer.”—Holotypus, *Brewer 1259*, GH! isotypus, US!—*Tragacantha oxyphysa* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca oxyphysa* (Gray) A. Hell., Muhlenbergia 2: 86. 1905.

The Stanislaus milk-vetch, *A. oxyphysus*, is one of the handsomest astragali, the flourishing adult plant forming noble clumps of stout, ascending stems. These are clothed in softly hairy leaves and from above the middle send forth three to six long racemes of nodding, ivory-white flowers succeeded by large, pendulous, papery fruits of lustrous, semitransparent texture. The outline of the pod, as seen in profile, varies from half-elliptic when the ventral suture is nearly straight to rhombic-elliptic when both sutures are bowed. The pod is usually broadest above the middle and acuminate downward, but sometimes acuminate toward both ends from near the middle. Jepson (1936, p. 349) has drawn attention to the white spot formed by the densely pubescent foliage developing above the flowering nodes, a feature not obvious until late in the season. The same silvery tops are found in the partly sympatric *A. asymmetricus*, and in one species of the desert interior, *A. (Preussiani) sabulosus*. The leaves of basal shoots produced toward the end of the active cycle of growth, early in June or thereabouts at low elevations in the San Joaquin Valley, are likewise more densely hairy than the more rapidly expanded vernal foliage.

No difficulty should be experienced in recognizing the Stanislaus milk-vetch once its unique characters are understood; but it does resemble one other astragalus of the region, *A. asymmetricus*, in stature and flower-size and the two species have often been confused. They may be distinguished by the following contrasts:

1. Pubescence of the leaves and calyx villosulous; *pod* elevated on a villosulous gynophore 3–11 mm. long, the body laterally compressed, carinate by the salient sutures, cuneately or acuminate narrowed downward into the joint with the gynophore; *ovules* mostly 12–18 *A. oxyphysus*
1. Pubescence of the leaves and calyx silky-strigulose; *pod* elevated on a genuine stipe 1.4–4 cm. long, the body obliquely, balloon-shaped, not or only a trifle compressed laterally (the sutures not salient), cuneately to subtruncately contracted at base into the stipe; *ovules* mostly 18–30 *A. asymmetricus*

The Stanislaus milk-vetch has been of ill repute as a stock poison since the early days of settlement in California. According to Ernest Twisselmann, who has very kindly provided me with detailed information about the locoweeds of the Great Valley and South Coast Ranges, *A. oxyphysus*, sometimes called the diablo loco, is acknowledged toxic to cattle, sheep, and horses. The plants are rapidly fatal to sheep. Cattle suffer severely, but do not become addicted and ordinarily avoid browsing the astragalus if other forage is available. Horses are affected less by *A. oxyphysus* than by *A. asymmetricus*, although once they acquire a taste for the weed, the disease follows the same course, leading to complete neurological collapse. Twisselmann points out that *A. oxyphysus* grows in a drier belt than *A. asymmetricus* and is green for a shorter time; on this score it is the less dangerous of the two. Much effort has been expended on control of *A. oxyphysus*, but it is still locally abundant and in no danger of extinction. Chemical sprays have been used against it, but even though these are effective temporarily, unremitting vigilance is required, the species soon becoming abundant again on neglected land.

LXVIII. Sectio TRICHOPODI

Caulescent perennials, usually stout, with superficial root-crown and at length basally indurated stems; *stipules* either all free, or some lower ones connate; *leaves* imparipinnate, with mostly 21–35 leaflets; *racemes* rather loose, mostly 15–50-flowered, the flowers nodding, of moderate size, the banner 11.5–19 mm. long; *pedicels* persistent; *calyx-tube* campanulate, sometimes deeply

so; *petals* mostly whitish or cream-colored, the banner rarely pink-veined, the bluntly or sharply deltoid keel-tip sometimes faintly maculate; *pod* pendulous, stipitate, persistent on the receptacle, the body varying from linear-elliptic to broadly and obliquely ovate-elliptic or half-ovate in profile, strongly compressed and two-sided or inflated and bladdery, the thin, green valves becoming papery and stramineous, not or very narrowly inflexed; *dehiscence* apical and sometimes also down the length of the ventral suture; *ovules* (10) 12–30.—Spp. 2, xerophytes, of the South Coast Ranges and west edge of the Great Valley, California, and of the southern California coast and islands southward into northern Baja California.

ASTRAGALUS sect. TRICHOPODI (Rydb.), comb. nov., based on *Phaca* subgen. *Podocystis* sect. *Trichopodae* Rydb. in N. Amer. Fl. 24: 335. 1929.—Sp. lectotypica: *P. trichopoda* Nutt. = *A. trichopodus* (Nutt.) Gray.

Astragalus sect. *Inflatii* subsect. *Trichopodes* Jones, Rev. Astrag. 96, in clave. 1923.—Sp. typica: *A. trichopodus* (Nutt.) Gray.

Astragalus sect. *Inflatii* subsect. *Leucophylli* Jones, l.c., pro max. parte. 1923.—Sp. typica: *A. leucophyllus* T. & G. = *A. asymmetricus* Sheld.

The sect. *Trichopodi*, of which the probable affinities have been discussed in the foreword to sect. *Densifolii*, is here restricted to two amply leafy species of cismontane and coastal California, which have nodding, whitish flowers and pendulous, stipitate, emmenoloboid pods. The body of the pod varies from linear-elliptic in profile, when it resembles that of *A. filipes* of sect. *Cusickiani*, to very broadly and obliquely ovate and bladdery, when it simulates that of some *Densifolii*, except that it is always elevated out of the calyx on a true stipe and not, as in *A. (Densifolii) curtipes* or *oxyphysus*, deciduous by a joint from a stipelike gynophore.

Gray brought together the elements of the section known to him (1864, p. 217) into a natural group forming part of the very large and heterogeneous sect. *Inflatii*, and Jones retained them there (1923, l.c.) under the title of two subsections distinguished by width and compression of the pod. However, the transition from a narrow, two-sided pod into one greatly swollen is now believed to occur within the compass of the one polymorphic species *A. trichopodus*. Out of exaggerated respect for these same carpological differences, Rydberg (1929, p. 274, 335–6) dispersed parts of this species among two genera, *Homalobus* and *Phaca*.

Key to the Species of sect. *Trichopodi*

1. Stipules at base of the stems connate, at least in veneration, the sheath sometimes ruptured or deciduous in age; *calyx-tube* deeply campanulate, 5–7.2 mm. long, 3–4.3 mm. in diameter; *petals* little graduated, the banner-blade poorly developed, little recurved, but its distal margin folded back in age, the flower in consequence blunt in profile; *stipe* of the *pod* 1.4–4 cm. long, the body bladdery-inflated, strongly oblique, the dorsal side gibbous-convex; South Coast Ranges and adjoining Great Valley, Kern and San Luis Obispo Counties n.-ward 256. *A. asymmetricus*
1. Stipules (except rarely on the Channel Islands) free; *calyx-tube* shallowly campanulate, 3.6–5.4 mm. long, mostly 2.5–4.2 mm. in diameter; *petals* decidedly graduated, the well-developed blade of the banner recurved through about 40°; *stipe* of the *pod* 0.5–1.7 cm. long, the body variable in outline and inflation, but if greatly swollen and oblique then the range insular and coastal from Ventura County s. into Baja California 257. *A. trichopodus*

256. ASTRAGALUS ASYMMETRICUS

Tall, stout perennial, with woody a taproot and at length basally indurated stems, densely silky-strigulose throughout with fine, appressed or narrowly ascending and (especially upward) a few longer, loosely ascending or spreading straight or largely straight hairs up to 0.4–0.65 (0.75) mm. long, the herbage greenish-cinereous or, late in the season, canescent, the leaflets equally pubescent on both sides or a trifle more densely so above than beneath, exceptionally glabrous above; *stems* erect or ascending in well-furnished clumps, 5–12 dm. long, striate, hollow and purple-tinged proximally or nearly throughout, branched or spurred at 1–several nodes preceding the first of (1) 3–12 peduncles, commonly zigzag above;

stipules scarious, pallid, or stramineous, 2–14 mm. long, dimorphic, the lowest amplexicaul and connate through half their length or more into a bidentate sheath (this often ruptured in age by expansion of the stem), the median and upper ones shorter, deltoid-acuminate from a broad, semiamplexicaul base, fragile and often deciduous in age, all thinly pubescent dorsally; *leaves* (5) 7–17 (20) cm. long, shortly petioled or the uppermost subsessile, with rather stiff, commonly recurving rachis and (17) 21–35 linear, linear-oblong, -elliptic, -lanceolate, or -oblanceolate, obtuse and mucronulate or shallowly emarginate, flat or loosely involute, dorsally carinate leaflets (3) 6–26 mm. long; *peduncles* stiffly erect, 6–24 cm. long, the lower ones surpassing, the uppermost about equaling the leaf; *racemes* loosely 15–45-flowered, the flowers early nodding, the axis much elongating, (5) 7–17 cm. long in fruit; *bracts* papery-scarious, narrowly triangular to linear-lanceolate, 1.5–4 mm. long, in age fragile and often deciduous; *pedicels* densely white-silky-pilous, at anthesis strongly arched or distally bent outward and downward, 1.2–2.2 mm. long, in fruit thickened, erect or narrowly ascending, straight or nearly so, 3.5–5 mm. long; *bracteoles* 0–2, minute when present; *calyx* (6.5) 8–11.4 mm. long, densely white-silky-strigulose, the slightly to strongly oblique disc 1.2–2 mm. deep, the deeply campanulate, basally turbinate or obliquely truncate tube 5–7.2 mm. long, 3–4.3 mm. in diameter, the lance-subulate teeth (1.5) 2–4.2 mm. long, the whole becoming papery, persistent unruptured; *petals* ochroleucous, immaculate, little graduated; *banner* very gently recurved distally but the distal margins abruptly folded back in late anthesis, broadly spatulate, entire or shallowly emarginate, 12.6–17.6 mm. long, 7–9 mm. wide; *wings* (0.2 mm. longer to 1.2 mm. shorter) 12.8–16.4 mm. long, the claws 7–9.7 mm., the narrowly oblong-oblanceolate, obtuse, erose-undulate, or obscurely emarginate, nearly straight blades 6.5–8.2 mm. long, 2.3–3.4 mm. wide; *keel* 11.5–14.7 mm. long, the claws 7–9.5 mm., the half-obovate blades 5–6.1 mm. long, 2.6–3.3 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.65–0.9 mm. long; *pod* loosely spreading or pendulous, stipitate, the slender, downwardly or sigmoidally arching stipe 1.4–4 cm. long, the very obliquely ovoid-ellipsoid or half-ovoid, bladdery-inflated body (2) 2.5–4.3 cm. long, 1.3–1.8 (or when pressed seemingly up to 2) cm. in diameter, broadly to narrowly cuneate at base, contracted distally into a deltoid or triangular-acuminate, laterally flattened beak 4–14 mm. long, the body a trifle compressed laterally, esculate, the sutures filiform, the ventral one slightly convex, straight, or gently concave-arcuate, the dorsal one gibbous-convex, the thin, pale green, sparsely strigulose valves becoming papery, stramineous, lustrous, finely reticulate, inflexed as a rudimentary septum 0.1–0.3 mm. wide, the funicular flange (at the middle of the pod) 1.5–2.5 mm. wide; *dehiscence* apical, through the beak; *ovules* (16) 18–30; *seeds* ochraceous or light brown, smooth but dull, 2.1–2.8 mm. long.—Collections: 38 (vi); representative: *C. F. Baker* 2818 (CAS, NY); *J. T. Howell* 5, 2397 (CAS), 24,364 (CAS, RSA); *Crum* 2075 (NY, WS); *Ripley & Barneby* 6952 (CAS, RSA); *Barneby* 11,265, 11,290 (CAS, RSA).

Dry grassy hills, fields, roadside banks, and rolling plains, 200–2500 feet, common and locally plentiful in the inner South Coast Ranges of California and adjoining Great Valley, from western Kern County and head of Salinas Valley in San Luis Obispo County north through the hill-country east of San Francisco Bay to Solano County.—Map No. 110.—April to July, occasionally again in fall.

ASTRAGALUS ASYMMETRICUS (oblique, of the pod) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a substitute for *A. leucophyllus* (white-leaved) T. & G., Fl. N. Amer. 1: 336. 1838 (non Willd., 1802).—"California, Douglas."—Holotypus, so labeled, NY (herb. Torr.)! isotypi, BM, G, K, OXF!—*Phaca leucophylla* (T. & G.) H. & A., Bot. Beechey 333. 1838. *Tragacantha*

leucophylla (T. & G.) O. Kze., Rev. Gen. 646. 1891. *A. leucopsis* var. *leucophyllus* (T. & G.) Jones, Contrib. West. Bot. 8: 23. 1898. *A. leucopsis* var. *asymmetricus* (Sheld.) Jones, op. cit. 10: 62. 1902.

The horse milk-vetch, *A. asymmetricus*, is a bold, handsome plant notable among the bladdery-fruited astragali of cismontane California for the length of the stipe, which may attain the extraordinary length of four centimeters. Next to the much smaller-flowered, diffuse or prostrate *A. Douglasii*, the species is the commonest astragalus of arid grasslands below 2000 feet in the inner Coast Ranges, whence it extends onto the floor of the Salinas and Great Valleys, here and there forming extensive colonies, especially on overgrazed land. The eastern margin of its range overlaps that of the habitually similar *A. oxyphysus*, which is, however, easily distinguished by its softer, villousulous vesture, more deeply campanulate or cylindric calyx-tube, more strongly graduated petals, and especially by the pod. This is technically sessile, deciduous from a gynophore much shorter than the stipe of *A. asymmetricus*, and although bladdery-inflated, at the same time strongly compressed laterally and bicarinate by the salient sutures. In San Benito County occurs a rare variant of *A. curtipes* in which the body of the pod is quite like that of *A. asymmetricus* in form; but this is ordinarily a greener plant, with shallower calyx-tube and a short, straight gynophore in place of the long, flexuous or sigmoidally arched stipe. The nearest relative of the horse milk-vetch is *A. trichopodus* var. *lonchus*, an essentially coastal astragalus which has been traced northward on the mainland no farther than Point Mugu in Ventura County. Here again the pod is similar in shape and texture, but the stipe is shorter (0.5–1.5 cm. long), the funicular flange much narrower, and the stipules, with very rare exceptions, are all free. The flower of *A. asymmetricus* is very characteristic because of the subequally long petals which present a blunt (or as Jones called it "stubby") appearance, viewed in profile.

The horse milk-vetch or horse loco, as it is often called, is one of the most widely known and feared weeds of the range in the dry inner valleys and hills of California. It is especially attractive to horses, which develop a craving for the plant and once addicted are never really cured. Ernest Twisselmann (personal communication) described the course of loco disease in horses as remarkably similar to narcotic addiction in human beings; if allowed to run its course, it culminates in hallucinations and loss of muscular coordination, and finally a complete neurological collapse, complicated by malnutrition, leads to death. Cattle are less often affected, avoiding the weed when forage is offered, and after periods of sickness may recover. With the mechanization of farming and the obsolescence of the horse as a source of power and locomotion, the problem of *A. asymmetricus* has become less acute than formerly, but according to Twisselmann attempts to control the horse loco are standard practice on well-managed ranches.

257. ASTRAGALUS TRICHOPODUS

Commonly robust, sometimes relatively slender, erect or less often diffuse, bushy-branched perennial, with thick, woody taproot and at length knotty trunk, suffruticulose caudex, or at least basally indurated stems, finely strigulose or strigulose-villosulous with appressed and sometimes a few or many narrowly ascending, straight or largely straight hairs up to 0.3–0.7 mm. long, the stems commonly canescent distally, sometimes throughout, the herbage greenish, cinereous, or canescent, rarely (in age, or in dry situations) white-tomentulose, the leaflets either glabrous or pubescent above; *stems* several or very numerous, erect and ascending or (especially when hanging out from steep banks or bluffs) assurgent and trailing, (2) 2.5–8 (10) dm., rarely dwarfed and only 0.5–2 dm. long, branched or spurred at all or most nodes preceding the first peduncle, striate and usually hollow proximally, together forming handsome leafy and floriferous clumps; *stipules* thinly herbaceous becoming papery, fragile and (especially the lowest) deciduous in age leaving a scar or low collar on the stem, broadly deltoid-acuminate to lanceolate or lance-acuminate, (2) 3–7 mm. long, usually decurrent around half or less of the stem's circumference (exceptionally the lowest connate; cf. an insular form of var. *lonchus* discussed below), the blades commonly deflexed; *leaves* (2.5) 5–16 (20) cm. long, the lowest shortly petioled, the rest subsessile, with (15) 21–35 (39) ovate- or lance-oblong, oblong-elliptic or -oblanceolate, rarely (upward) linear-oblong or (downward) ovate- or obovate-cuneate, obtuse, obtuse and mucronulate, or emarginate, flat or loosely folded leaflets (2) 5–20 (25) cm. long; *peduncles*

erect or incurved-ascending, (4) 6–26 (30) cm. long, all but the shortest upper ones surpassing the leaf; *racemes* loosely or a first rather densely (10) 15–50-flowered, the flowers early spreading and nodding at full anthesis, the axis nearly always elongating, (2) 3.5–13 (16) cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–3.3 mm. long; *pedicels* at first ascending, straight, early arched out- or downward or divaricate in age, at anthesis 1.2–2.6 (4) mm., in fruit thickened, 1.4–5.2 mm. long, persistent; *bracteoles* commonly 2, sometimes rudimentary or 0; *calyx* 5–8.7 mm. long, thinly or sometimes only minutely strigulose or strigulose-villosulous with white, sometimes mixed with fuscous or black hairs, the oblique disc (0.8) 1–1.5 mm. deep, the pallid, campanulate tube 3.6–5.4 mm. long, (2.2) 2.5–4.2 (4.8) mm. in diameter, obliquely turbinate, rounded, or a little distended dorsally (but scarcely gibbous) at base, the subulate teeth (0.9) 1.1–3.7 mm. long, the orifice often oblique, the whole becoming papery, marcescent unruptured; *petals* greenish-white or cream-colored, rarely yellowish or white veined with pink-purple, the keel nearly always concolorous, the tip sometimes faintly maculate, the wing- and keel-claws exerted from the tube; *banner* recurved through 40–45° (or further in withering), rhombic-ovate, -elliptic, or -oblanceolate, shallowly notched, 11.3–19 mm. long, (5.4) 5.7–10 mm. wide; *wings* (10.1) 10.4–16.1 mm. long, the claws (4.6) 5–7.9 mm., the linear or narrowly oblanceolate, obtuse, erose, or rarely emarginate, straight or slightly incurved blades 6.3–9.7 mm. long, 1.6–3.2 mm. wide; *keel* 8.6–13.3 mm. long, the claws 4.5–7.8 mm., the obliquely triangular or broadly half-obovate blades 4.6–6.3 mm. long, (2.2) 2.4–3.4 mm. wide, abruptly incurved through 85–95° to the bluntly deltoid or sometimes subporrect and then sharply deltoid apex; *anthers* 0.5–0.8 (0.9) mm. long; *pod* pendulous, stipitate, continuous with the receptacle, the filiform, flexible, straight or downwardly arched, strigulose-villosulous, green or often brownish-purple stipe 5–17 mm. long, the body varying (according to variety) from linear-elliptic to broadly and plumply ovate or half-ovate in profile, laterally compressed when narrow, otherwise more or less greatly inflated, often bladdery, (1.3) 1.5–4 (4.5) cm. long, 4.8–21 mm. in diameter, the thin, pale green or purplish-tinged, glabrous or finely strigulose valves becoming papery, stramineous, lustrous, finely cross-reticulate, not inflexed, the funicular flange 0–0.6 mm. wide; *dehiscence* apical and downward through the ventral suture, sometimes its whole length and the valves then explanate in age; *ovules* (10) 12–30; *seeds* brown, dark chocolate-brown, or greenish, smooth, pitted, or wrinkled, dull, (1.8) 2–3.2 mm. long.

The complex of forms assembled here under the specific heading of *A. trichopodus* has traditionally been treated, if we ignore for the moment some inconsiderable segregates, as three distinct species, *A. trichopodus* (sens. strict.), *A. leucopsis*, and *A. Antiselli*, equivalent to our vars. *trichopodus*, *lonchus*, and *phoxus* respectively. Jepson at one time (1925, p. 572) reduced *A. Antiselli* to varietal rank, but in his summary Flora he again separated them. The wealth of material now available permits an assessment of the essential differences which prove to be much less numerous than supposed, existing only in the fruit. It is true that the hairs on the stems and leaves of var. *lonchus* are more often, in whole or part, of a more sinuous type than has been observed in the other varieties, but the vesture is quite variable, and some specimens of var. *lonchus* and var. *phoxus* are indistinguishable on this basis. Turning to the pod, we find an almost uninterrupted series of variants from the narrow, commonly symmetric, laterally flattened one characteristic of var. *phoxus* into the broadly and plumply inflated, strongly asymmetric one normal to var. *lonchus*, with the moderately inflated, either symmetric or asymmetric pod of var. *trichopodus* neatly intermediate between the extremes. The nearest approach to discontinuity in the series falls between the tumid pod of var. *trichopodus* and the flat, two-sided, and sharply bicarinate pod of var. *phoxus*; but the coastal form of the latter, which has been called *A. gaviotus* and has unusually broad and sometimes subtumescens fruits, very closely simulates the narrowest and least inflated states of var. *trichopodus*.

The geographic dispersal of the three varieties deserves special notice, because of the bearing it may have on the taxonomic situation. Typical var. *trichopodus* is comparatively rare,

much more restricted and discontinuous in range than the other two varieties. In the first place it occupies a very short stretch of coastal territory in northern Ventura and southeastern Santa Barbara Counties lying precisely between (but not overlapping) the northernmost mainland outpost at Point Mugu of var. *lonchus* and the first appearance of var. *phoxus* on the coast a few miles west of Santa Barbara. The second and, so far as number of colonies and individuals are concerned, the most important area for var. *trichopodus* embraces the low Puente and Chino Hills, a region less than twenty miles in greatest diameter and exactly interposed between the southeastern outposts of var. *phoxus* in the foothills of the Verdugo Hills and the Pacific slope of the Santa Ana Mountains. It is precisely here that var. *lonchus* deserts the immediate shoreline and climbs a little inland along canyons running to the ocean. The third station for var. *trichopodus* is Catalina Island, where it is known only from the bay of Avalon; var. *lonchus* is found elsewhere on the island in wilder spots. Possibly var. *trichopodus* is introduced there. A glance at Map No. 112 will show the continuous range of var. *lonchus* from the Santa Maria Plains in Baja California north along the coast to Point Mugu and the Channel Islands, and that of var. *phoxus*, mostly back of the shoreline, from San Fernando Valley northwest to central San Luis Obispo County, with a few odd coastal stations between Santa Barbara and Point Conception. The position of var. *trichopodus*, intermediate morphologically in the pod and geographically (except on Catalina Island, where perhaps irrelevant) between var. *lonchus* and var. *phoxus*, suggests two hypotheses. The intermediate form might be interpreted as having arisen, possibly independently in its two main areas, through hybridization between two distinct species, *A. Antiselli* to the north and *A. leucopsis* to the south; or alternatively as a somewhat artificial and arbitrary selection of specimens taken out for convenience from too long a series of intergradient forms. Before considering the merits of either hypothesis it is necessary to introduce a fourth species, *A. filipes*, which may have been involved in the formation of the *A. trichopodus* complex.

Predominantly a species of the sagebrush deserts of the Great and Columbia Basins, *A. filipes* reappears strangely and disjunctly in the interior mountains of southern California and extreme northern Baja California, where its few scattered stations indicate a relictual occurrence. It is easily distinguished from *A. trichopodus* by its subterranean root-crown and connate lower stipules; but the pod, detached from the plant, is almost precisely that of var. *phoxus* in form even though it dehisces (as does that of related intermountain species) first from the base and through the stipe, not apically (as in all forms of *A. trichopodus*). While var. *phoxus* is characteristic of the chaparral belt below 3000 feet altitude, it extends occasionally, as along Piru and Sespe Creeks in Ventura County, upward to the 4000 feet contour where it very nearly approaches some outlying colonies of var. *filipes* on the flanks of Mount Piños. The possibility of pollen exchange in this area cannot be overlooked; moreover, in view of its present disjunct dispersal, *A. filipes*, must have ranged more widely in California in the past, so other opportunities may have arisen in former times. Such hypothesis would go far to explain the astonishing similarity in the pods of vicariant species which do not appear otherwise at all closely related.

With extreme regret I am obliged to revive, at the varietal level, and at the expense of the familiar epithets *leucopsis* and *Antiselli*, two names which are not only odd in form but based originally on minor variants of no distinction. The argument for adopting the category of *subspecies* in place of the classical *varietas* here assumes a certain force.

Key to the Varieties of *A. trichopodus*

1. Body of the pod bladdery-inflated or strongly tumid, little or not at all laterally compressed, the lateral faces convexly rounded (2)
2. Body of the pod (1.7) 2-4 (4.5) cm. long, (0.8) 1-1.8 (2.1) cm. in diameter, bladdery-inflated, greatly oblique, nearly always openly sulcate ventrally, the ventral suture straight, shallowly concave, or low-convex, but much less convex than the dorsal one; *ovary* and pod pubescent n. of San Diego, sometimes glabrous s.-ward; coastal, rarely a little way inland along seaward-running canyons, n. Baja California to Ventura County, California, and Channel Islands 257a. var. *lonchus*
2. Body of the pod (1.3) 1.5-3.5 cm. long, (5) 6-10 (13) mm. in diameter, inflated or tumid, symmetrically fusiform-ellipsoid or sometimes strongly oblique, the sutures equally convex or the ventral one straight and the dorsal low-convex; *ovary* and body of the pod nearly always glabrous; n. Orange and immediately adjoining counties, California; coastal in n. Ventura and e. Santa Barbara Counties; Catalina Island 257b. var. *trichopodus*
1. Body of the pod laterally compressed, bicarinate by the sutures, the lateral faces flat or very low-convex; *pod-body* glabrous or rarely strigulose, 1.5-3.6 cm. long, 4.8-9 mm. in diameter, symmetric or oblique; inland from Los Angeles to San Luis

Obispo County, California, reaching the coastal bluffs in s.-w. Santa Barbara County 257c. var. *phoxus*

257a. ASTRAGALUS TRICHOPODUS var. LONCHUS

Loosely strigulose-villosulous with shorter, sinuous or curly together with some or many longer, ascending or spreading and incurved, more rarely all straight and subappressed hairs up to 0.4–0.75 mm. long, the stems commonly canescent, the foliage greenish-cinereous to almost white-felted, the leaflets equally pubescent on both sides or medially glabrescent, even quite glabrous above; *stems* mostly erect or ascending in clumps; *racemes* (12) 15–36-flowered, the axis (2) 3.5–11 cm. long in fruit; *peduncles* (5.5) 8–20 (30) cm. long; *petals* greenish-white or cream-colored, rarely veined with pale pink or purple, the keel rarely pink-tipped; *banner* 11.3–19 mm. long; *keel* 8.6–13.3 mm. long; *stipe* of the pod 5–15 mm. long, the *body* very obliquely ovoid, half-ovoid, half-ellipsoid, or lunately half-ellipsoid, (1.7) 2–4 (4.5) cm. long, (0.8) 1–1.8 (2.1) cm. in diameter, broadly cuneate or turbinate at base, contracted distally into a short, broadly deltoid, laterally flattened beak, shallowly sulcate ventrally, the valves finely strigulose with white or sometimes fuscous hairs, more rarely glabrous distally or throughout.—Collections: 105 (iii); representative: *C. B. Wolf 10,889* (CAS, NY, POM); *Abrams 3109* (NY); *Spencer 1087* (CAS, NY); *Wiggins 4292* (CAS, POM, SMU); *Ferris 8472* (NY, OB, POM), *8516* (NY, POM, SMU); *Palmer 700* (NY).

Coastal bluffs, mesas, and sandy fields near the ocean, sometimes hanging down from shaley clay cliffs or descending to shingle banks behind barrier beaches, mostly between 5 and 250 feet, but southward extending rarely up to 6 (10) miles inland and up to 1000 feet along seaward-running canyons, common and locally abundant in a narrow strip along the Pacific Ocean from Point Mugu, Ventura County, California, to the Santa Maria Plains in northern Baja California; Santa Cruz, Anacapa, and Catalina Islands, on the last also up to 1000 feet.—Map No. 112.—February to June and occasionally in fall and winter.

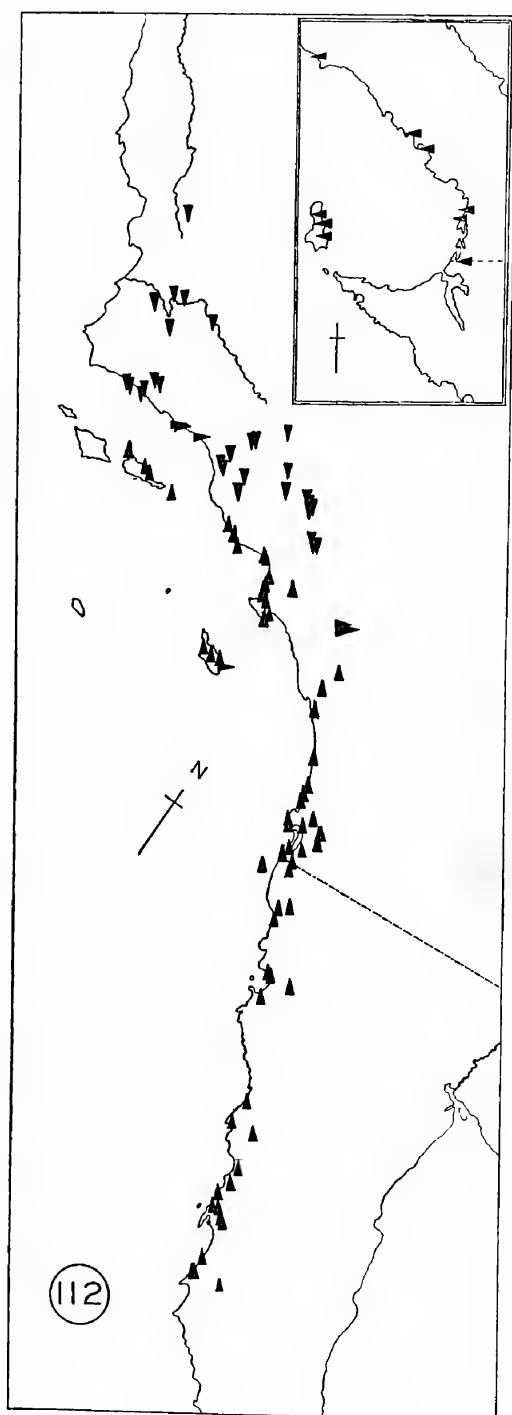
ASTRAGALUS TRICHOPODUS var. LONCHUS (Jones), comb. nov. based on *A. leucopsis* var. *lonchus* (long, of the peduncles) Jones, Rev. Astrag. 119, Pl. 19. 1923.—“This is my No. 3083 from San Diego . . .”—Holotypus, collected by Jones on March 17, 1882, POM (2 sheets)! isotypi, CAS, NY!

Phaca canescens (turning white) Nutt. ex T. & G., Fl. N. Amer. 1: 344. 1838—“With the preceding . . . [i.e., *P. trichopoda*: ‘near the sea, St. Barbara, California.’], Nuttall.”—Holotypus, labeled by Nuttall “*Phaca *canescens*. Sta. Barbara, U. Calif.,” BM! isotypi, K, NY, PH! (cf. discussion for variation in labels).—*Phaca leucopsis* (appearing white) T. & G., op. cit. 1: 694. 1840, a legitimate substitute (non *P. canescens* H. & A., 1832). *Astragalus leucopsis* (T. & G.) Torr., Bot. U. S. & Mex. Bound. 56. 1859. *Tragacantha leucopsis* (T. & G.) O. Kze., Rev. Gen. 946. 1891.

Phaca encenadae (of Ensenada) Rydb. in N. Amer. Fl. 24: 336. 1929 (“*Encenadae*”).—“Type collected at Ensenada, Lower California, April 12, 1882, M. E. Jones 3672 . . .”—Holotypus, actually Jones 3675, NY! Spms. collected the same day but numbered “Jones 3676” (POM, 2 sheets) or “Jones 3675” (CAS, NY) are probably isotypi.

The ocean milk-vetch, var. *lonchus*, is listed first in order of precedence to emphasize the presumably primitive condition of the pod, through which the relationship of the whole species to *A. asymmetricus* is perceived. Within its range of dispersal the variety is the only astragalus (except for the nearly or perhaps actually sympatric var. *trichopodus* on Catalina) with pod at once greatly inflated and stipitate. Care, however, must be taken on the northern Channel Islands to distinguish the superficially similar *A. curtipes*, in which the shorter “stipe” is in reality a gynophore.

The variety is quite variable in size of the flower, in length of the calyx-teeth, and in density and distribution of the vesture, and the variations are correlated in some degree with distribution. Species such as this, confined to a narrow coastal strip, consist of a linear sequence of populations, and it is not surprising to find some characters becoming dominant at one end



Map No. 112. Parts of California and Baja California, from the head of the Salinas River south to Rosario, and (inset) coastal Baja California in lat. 27° – $29^{\circ} 40'$ N., showing Cedros Island and Sebastián Viscaíno Bay. Range of *A. trichopodus*: $\blacktriangle$ var. *trichopodus*; $\blacktriangle$ var. *lonchus*; $\blacktriangledown$ var. *phoxus*; and of $\blacklozenge$ *A. fastidius*.

or the other, for the reticulate pattern of gene exchange feasible in organisms of continental dispersal is here hardly possible. In var. *lonchus* large flowers are prevalent northward, the smallest flowers occurring only in Lower California. Densely canescent foliage is common southward and only occasional northward. The pod is consistently strigulose north of San Diego and not infrequently glabrous below the boundary. The calyx-teeth southward are rarely more than 2 mm. long and commonly over 2 mm. northward. The correlation is incomplete, and no effective differentiation into discrete geographic races is apparent.

The vesture of var. *lonchus* is commonly composed of short, more or less crisped hairs mixed with longer, straighter, ascending ones, but either sort may predominate and occasionally one sort is absent or nearly so. The fluctuations are rather sporadic in distribution, even though plants of a given population are commonly alike in this respect. On the other hand, the leaflets sometimes vary in one small colony from glabrous to pubescent above.

A more important variant of var. *lonchus* occurs occasionally on Catalina and Santa Cruz Islands. Here plants are found apparently indistinguishable from the normal form except that the stipules, at least low on the stems or low on the more slender, lateral branches, are fully amplexicaul and connate-sheathing (cf. *Fosberg* S4778, S4618, POM, and *C. B. Wolf* 2751, RSA). Free-stipuled plants have been collected more commonly on both islands. It must be left to future field workers to discover whether the variants occur together or in separate populations.

As originally defined, var. *lonchus* was thought to differ from typical *A. leucopsis* in its elongate peduncles and flowers faintly suffused with purple coloring. There is no visible trace of anthocyanin in the type-series so far as known to me, and the plants appear to represent no more than robust minor variants easily matched in any large set of specimens. Rydberg's *P. encenadae* is the state with glabrous fruit, although some isotypi have a few hairs on the proximal half of the pod-body. The species has been collected repeatedly near Ensenada, where glabrous- and puberulent-fruited plants are found in about equal numbers.

The distribution of var. *lonchus* is so compact and natural that I have hesitated to incorporate in the range or map some strikingly discrepant data. In the first place the type-locality at Santa Barbara is almost certainly an error. The variety has not been seen since on the mainland north of Point Mugu, a point on the coast about forty miles southeast of Santa Barbara; it was unknown in the Santa Barbara region to C. F. Smith (Fl. Santa Barb. 43. 1952). Significantly the Nuttall labels associated with his *Phaca canescens* read at NY simply, "Upper California" and at PH "Angeles," and it seems likely that the "dry plains," hardly descriptive of the country around Santa Barbara, were in reality much farther south. Specimens labeled "Nanaimo, Vancouver Island" (*J. Macoun* 125, ND, NY) must surely have been a chance introduction, possibly in ballast from San Pedro or San Diego harbors. A specimen from "Piñería Alta, Sonora," collected by Schott (NY), may have originated at San Diego where the Boundary Survey naturalists botanized extensively; at least there is no modern record to substantiate an improbable range-extension.

257b. ASTRAGALUS TRICHOPODUS var. TRICHOPODUS

Essentially like the commoner var. *phoxus* up to the pod; *banner* 11.5–15.4 mm. long; *keel* 9.5–11.5 mm. long; *stipe* of the pod 6.5–17 mm., the body turgidly and narrowly or sometimes plumply ellipsoid or half-ellipsoid, (1.3) 1.5–3.5 cm. long, (5) 6–10 (13) mm. in diameter, the sutures equally convex or the ventral one straight, the valves commonly glabrous, very rarely strigulose.—Collections: 15 (o); representative: *Eastwood* 1416 (CAS, NY); *Rixford* (from Avalon) in 1914 (CAS, NY); *J. T. Howell* 2415 (CAS).

Shale or sandstone outcrops on ocean bluffs or low grassy hills, rare and local except in a few stations where forming colonies, known only from three restricted areas in southern California; coastal, below 300 feet, southeastern Santa Barbara and immediately adjoining Ventura Counties; south end of Catalina Island (Avalon Bay); inland, up to 1100 feet, on the Puente and Chino Hills in northeastern Orange and immediately adjacent Los Angeles and San Bernardino Counties.—Map No. 112.—March to June, occasionally in fall and winter.

ASTRAGALUS TRICHOPODUS (Nutt.) Gray in Proc. Amer. Acad. 6: 218. 1864, based on *Phaca trichopoda* (with hairlike stipe) Nutt. ex T. & G., Fl. N. Amer. 1: 343. 1838.—"Borders of woods near the sea, St. Barbara, California... Nuttall."—Holotypus, labeled by Nuttall "*Phaca (Phytophaca) macropoda* [the epithet and asterisk **inflata* erased] U. Calif.," BM (in part, mixed with var. *lonchus*)! isotypi, labeled "*Phaca (*Phytophaca) longipoda*. St. Barbara,

Calif.," GH, PH, or "*Phaca trichopoda*. Santa Barbara," K!—*Tragacantha trichopoda* (Nutt.) O. Kze., Rev. Gen. 948. 1891.

Astragalus capillipes (with hairlike stipe) Jones, Rev. Astrag. 117, Pl. 18. 1923.—"The type material from Blanche Trask Catalina Island, also material from the island from Brandegees . . ."—Holotypus, collected by Trask, May 22, 1901, POM! isotypus, NY! paratypes, Trask in June, 1901, GH, UC (herb. Brand.) POM (fragm.), and in June, 1900, UC (herb. Brand.)!—*A. trichopodus* var. *capillipes* (Jones) Jones, l.c., in syn., nom. provis.; Munz & McBurney ex Munz in Bull. S. Calif. Acad. Sci. 31: 67. 1932. *Phaca capillipes* (Jones) Rydb. in N. Amer. Fl. 24: 336. 1929.

Variation in length, outline, and inflation of the pod of the Santa Barbara milk-vetch, var. *trichopodus*, has been ably analyzed by Jepson (1936, p. 368), and the point needs no further emphasis. I can only add that one collection mentioned by Jepson, Miss Eastwood's from Gaviota, represents the coastal phase of var. *phoxus* mentioned under the following variety. Maintaining *Phaca capillipes* as a species, Rydberg emphasized the pod's oblique outline, but equally asymmetric pods are found in some inland stations. There is no difference in the flowers. I am inclined to question whether var. *trichopodus*, which grows somewhat weedly on the sea bluffs around Avalon Bay (vidi!), is truly native on Catalina. Avalon, according to the isotypus label at NY, is the type-locality of *A. capillipes* and the species has apparently not been collected elsewhere on the island.

257c. ASTRAGALUS TRICHOPODUS var. PHOXUS

Finely strigulose or strigulose-villosulous with appressed and often a few ascending, straight or largely straight hairs up to 0.3–0.7 mm. long, the stems commonly canescent distally, the herbage cinereous, greenish, or in youth canescent, the leaflets usually glabrous, occasionally pubescent above; *peduncles* (4) 6–26 (30) cm. long; *racemes* (10) 20–50-flowered, the axis (2) 3.5–13 (16) cm. long in fruit; *petals* greenish-white or cream-colored, immaculate; *banner* (11.4) 12.4–16.7 mm. long; *keel* (9.3) 9.7–12.7 mm. long; *stipe* of the pod (6) 7–13 (15) mm. long, the *body* oblanceolate or linear-elliptic in outline, (1.5) 2–3.6 (4) cm. long, 4.8–9 (11) mm. in diameter, tapering downward into the stipe, cuneate and mucronate at apex, straight and symmetric or more rarely somewhat oblique distally (the dorsal suture then the more strongly convex), the valves commonly glabrous, rarely (in the proximal half or throughout) finely strigulose.—Collections: 40 (iv); representative: *Eastwood & Howell 4150* (CAS, NY); *Barneby 11,283* (CAS, RSA); *Eastwood 55* (CAS, NY); *Elmer 3616* (DS, NY); *Munz 13,155* (POM, WS); *J. T. Howell 3720* (CAS).

Grassy and brushy hillsides, washes, and openings in chaparral, sometimes locally abundant on roadcuts and firebreaks, 100–3000 (4000) feet, widespread and locally common from the foothills surrounding the plain of Los Angeles and San Fernando Valley northwest, back from the ocean, through the Liebre, Topatopa, Santa Ynez, and San Rafael Ranges to Cuyama Valley and north, becoming rarer, to the head of the Salinas River and the south end of the Santa Lucia Mountains, Los Angeles to central San Luis Obispo County, California; also extending feebly east to the edge of the Mohave Desert in Antelope Valley; and coming out onto grassy ocean bluffs along the coast of Santa Barbara County between Santa Barbara and Point Conception.—Map No. 112.—February to June, sometimes again in fall or winter.

ASTRAGALUS TRICHOPODUS var. PHOXUS (Jones), comb. nov., based on *A. Antiselli* var. *phoxus* (pointed, of the pod) Jones, Contrib. West. Bot. 10: 65. 1902.—No locality or collector mentioned; in Rev. Astrag. 72. 1923: "Santa Ynez River, southern California and vicinity," but the data irrelevant.—Holotypus, *Parish 1886*, collected in San Francisquito Canyon, Los Angeles County, California, June, 1887, UC (herb. Brand.)! isotypi, ND, POM (fragm.)!

Astragalus Antiselli (Thomas Antisell, 1817–1893, geologist and botanist with Lieut. Parke's Expedition, 1854–5) Gray ap. Brewer & Wats., Bot. Calif. 1: 152. 1876.—"Hillsides, Santa Barbara Co.; Santa Ynez (Dr. Antisell) . . ."—Holotypus, collected by Asa Gray in 1885, "very common in upper part of Santa Clara valley," fruct., GH! isotypi, P, POM (fragm.)! paratypes, *Antisell* (flor.), GH!—*Homalobus Antiselli* (Gray) Rydb. in Bull. Torr. Club 50:

271. 1923. *A. trichopodus* var. *Antiselli* (Gray) Jeps., Man. Calif. 572, fig. 561. 1923 ("antiselli").

Astragalus Hasseanus (Hermann Edward Hasse, 1836–1915, resident of Santa Monica) Sheld. in Minn. Bot. Stud. 1: 124. 1894 ("hasseanus").—"Collected near San Bonaventura, California, September, 1888, by Dr. H. E. Hasse."—Holotypus, MINN! isotypus (*Hasse 4200*), NY!

Astragalus gaviotus (of Gaviota) Elmer in Bot. Gaz. 39: 54. 1905.—"... at Gaviota, Santa Barbara county, California, May, 1902. Type specimen, no. 3759, in Herb. Stanford University."—Holotypus, DS! isotypi, G, GH, NY, ORE, P, US!—*Homalobus gaviotus* (Elmer) Rydb. in Bull. Torr. Club 50: 272. 1923. *A. trichopodus* var. *gaviotus* (Elmer) Jeps., Man. Calif. 371. 1925. *A. Antiselli* var. *gaviotus* (Elmer) Munz ex Munz & McB. in Bull. S. Calif. Acad. Sci. 31: 67. 1932.

The pod of the Antisell milk-vetch, *A. trichopodus* var. *phoxus*, is variable in outline and pubescence. In the form prevalent through the chaparral belt back from the immediate coast, the body of the fruit is glabrous, subsymmetrically oblanceolate in profile, and mostly 2–3.5 cm. long, 5–7 mm. in diameter. The stipe is always strigulose, and the vesture sometimes advances upward along the ventral or both sutures and more rarely extends over the proximal half of the valves. Occasionally the pod-body is asymmetric, the ventral suture becoming straight or nearly so and the dorsal one convex. On the coastal bluffs of eastern Santa Barbara County, the variety is represented by the variant described as *A. gaviotus*, distinguished by a relatively broad pod mostly 1.5–2.5 cm. long and 7–9 mm. in diameter, strigulose throughout. There are a few examples, however, of pods reaching a width of 8 mm. in the interior; and in one coastal population of *A. gaviotus* the fruits on some plants were found to be glabrous, on others pubescent. On the coast the raceme is relatively compact, the axis becoming 2–4 cm. long as opposed to 4–16 cm. long in the hinterland. The differential characters of *A. gaviotus* seem too tenuously correlated one with another to deserve systematic notice.

Both *A. gaviotus* and *A. Hasseanus*, listed above as synonyms of var. *phoxus*, have been the subject of controversial treatments in the past. The former has been assessed as a variety of *A. Antiselli* (merged with var. *phoxus*), as an independent variety of *A. trichopodus*, or merged with the latter (Jepson, 1936, p. 368), a disposition which seems phytogeographically probable, since *A. trichopodus* is mostly coastal and var. *phoxus* otherwise of interior range. However, the pod of *A. gaviotus* is strongly compressed and two-sided, not turgid as in typical *A. trichopodus*. I agree with Rydberg (1929, p. 274) that *A. Hasseanus* is a synonym of *A. Antiselli* and not of *A. trichopodus*. Jepson (l.c.) favoring the latter view claimed that Ventura, the type-locality, lies outside the climatic region to which *A. Antiselli* is adapted. Nevertheless the typus has a strongly flattened pod; and var. *phoxus* has been collected subsequently about six miles north of Ventura, in Foster Park (*Eastwood 4962*, CAS).

The original diagnosis of var. *phoxus* would have the pod "long, large and narrower" by comparison with that of typical *A. Antiselli*. The fruit of the typus varies from 2 to 3.4 mm. long, long perhaps by comparison with that of the original *A. Antiselli*, but not exceptional in the species as known today. The locality as given in Jones's Revision has little to do with var. *phoxus* as originally conceived, but was apparently based on a collection from Santa Ynez Valley (*Hall 7846*) which dates back only to the year 1907.

LXIX. Sectio INFLATI

Caulescent, perennials, biennials, and vernal or winter annuals, with taproot and superficial root-crown or shortly forking caudex; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with (5) 7–35 leaflets; *racemes* few- to many-flowered, the flowers at first ascending, in age commonly spreading or declined, mostly small or very small, the *banner* (3.5) 5–16 mm. long; *pedicels* commonly persistent (deciduous with the fruit in *A. gruinus*; persistent in *A. oocarpus*); *calyx-tube* campanulate; *petals* white, whitish, ochroleucous, purple-tinged, or bright pink-purple (then often drying violet), regularly but often only slightly graduated, the keel or wings rarely longest, the keel-tip either rounded or narrowly triangular and beaklike; *pod* spreading, ascending, or declined, sessile on the receptacle or on a stipelike gynophore, disjuncting when ripe (except in *A. oophorus*, *A. gruinus*, and some South American spp.; tardily so in *A. Hornii*) varying from globose to ovate, lance-oblong or -elliptic in profile, usually inflated and bladdery, more rarely only a little or scarcely turgid, the valves papery or papery-membranous, not in-

flexed or inflexed as an incomplete (usually only rudimentary) septum, the funicular flange often well developed, sometimes 0; *dehiscence* apical and sometimes also tardily basal; *ovules* 6–58 (3–7 in *A. aridus*).—Spp. about 35, xerophytes (subsect. *Horniani* halophytes), 31 in North America and 3 or 4 in w. South America, most highly developed in intermountain and southwestern United States and northern Baja California, but extending from the lower Columbia River in southeastern Washington to the Big Horn and North Platte Rivers in Wyoming, south to trans-Pecos Texas, central Mexico, and from central cismontane California to the southern district of Baja California.

The *Inflati* are here restricted to species characterized by a superficial root-crown, free stipules, developed stems, small flowers with shallowly campanulate calyx, and a sessile, nearly always deciduous pod of papery or papery-membranous texture, which is ordinarily globose or symmetrically to very obliquely ovoid, greatly swollen or bladdery at maturity, and unilocular or nearly so. I have been obliged to include a few (particularly in subsect. *Sparsiflori*), however, in which the fruit is either partially bilocular, or hardly at all inflated, or even both. The epithet *Inflati* refers to the swollen fruit of the majority, but a bladdery legume has evolved in several lines of inheritance in *Astragalus*, and by no means all the North American species so characterized will be found here. The principal groups excluded from the *Inflati* despite a bladdery fruit are: sects. *Trichopodi*, *Cusickiani*, and *Phaca*, with pod at once stipitate and continuous with the receptacle; the largely oceanic *Anemophili* and *Densifolii*, with pods of genuine *Inflati* but connate stipules; the large-flowered *Oxyphysi* and *Megacarpi*, with pods deciduous from a gynophore; and several groups with small flowers and bladdery-ovoid pods, but connate stipules or subterranean caudex or both (*Jejuni*, some *Ervoidei*, *Polares*, and *Scytocarpi*), or technically similar except for the acaulescent habit (*A. desperatus*). Another category of species has been excluded somewhat arbitrarily, those that combine all critical vegetative features of sect. *Inflati* with a pod normally both inflated and fully bilocular, e.g., sects. *Diphyssi* or *Platytropes*. In some *Diphyssi* (vars. of *A. lentiginosus*) the pod is not more than semibilocular and is not technically different from that of *A. (Inflati) Geyeri* var. *triquetrus*. However, the *Diphyssi* have normally a longer and proportionately narrower flower with deeper calyx-tube than any genuine *Inflati* and have been excluded chiefly on this score.

The section is rather difficult taxonomically, due partly to the number of species, but more importantly to the lack of significant or tangible differences in the fruit of the majority. The bladdery pods prevalent in the section differ from one species to another in average size, and to some degree in the obliquity of the lateral profile, in development of a beak, in mottling of the valves, and in pubescence; but these are often slight and uncertain differences, and I am obliged to fall back on rather minute, or in the genus trivial, characters such as number of leaflets and flowers, exact size and sometimes even color of the petals, or ovule-number (often especially useful) in order to find ways of discriminating between related forms. A casual examination of the key below might suggest that extensive reductions in rank throughout the *Inflati* would not be amiss, and this course has been considered seriously but rejected. Some years ago, when I was preparing to describe *A. endopterus* and *A. aquilonius*, I felt that although they were unquestionably distinct entities, they lacked differential characters to distinguish them from *A. Wootoni* except at the level of variety; but at the time I had not seen deeply into the problem posed by the *Inflati* or faced the logical consequences of subordinating these perfectly distinct forms. Morphological discontinuities between species in the *Inflati* are often narrow and in the context of the genus comparatively trivial. Almost all the entities circumscribed by these discontinuities do, however, coincide neatly with dispersal-patterns which the experienced plant geographer will find familiar and convincingly natural. As soon as one begins to build up by accretion a hierarchy of subsidiary races around a nucleus of *A. Wootoni*, he embarks on a course which has no end but to include almost the whole section *Inflati* in one large and obviously unwieldy specific complex. The morphological hiatus between *A. Wootoni* var. *Wootoni* and *A. insularis* var. *quentinus* as expressed in technical terms is very slight, however impressive it may become in the light of the close relations of each; and the same might be said of *A. Wootoni* var. *Candollianus* on the one hand and *A. Gilmani* or *A. cerussatus* on the other. An inclusive concept of these forms as constituting a polymorphic macrospecies would have to be expanded further to take in several peripheral entities, such as *A. nutans*, *A. Wardi*, or *A. idrietorum*, whence the passage through *A. Palmeri*, and especially that form of it known as *A. Vaseyi* var. *Johnstonii*, could be accomplished by equally small steps into *A. Douglasii* and *A. macrodon*, a method of reduction which leads literally to the absurd. It should be emphasized that even those *Inflati* which are least well differentiated from their close kindred are (with rare exceptions, such as *A. allochrous*, discussed further in

the text) precisely delimited. The situation is quite different from that found in sect. *Diphysi*, where the varieties of *A. lentiginosus*, sometimes at least as distinct ideally one from another as are many *Inflati* accepted here as species, are almost everywhere confluent morphologically with a vicariant form.

The *Inflati* are arranged below in series which have been described as subsections, although they are not exactly definable as such. The general plan of the section runs in the first three groups from the soundly perennial to the fleeting annual, the last two being devoted to somewhat anomalous types. The genuine *Inflati* are true perennials with comparatively many ochroleucous flowers and many-ovulate fruits; they are essentially Californian, extending only a short way beyond the border of the Californian floristic province. The *Proriferi* are similar but less soundly perennial or biennial, with over ten ordinarily purple flowers to the raceme and 10–30-ovulate pods otherwise similar to the genuine *Inflati*. They are highly developed in Baja California, mostly at low elevations, and extend north into the Colorado Desert. The *Proriferi* lead directly into the annual or biennial (rarely short-lived perennial) *Aridi*, species of the southwestern deserts and Great Basin, with outliers as far afield as central Idaho, northwestern Wyoming, and central Mexico. The raceme of the *Aridi* is commonly less than 10-flowered and the leaflets and ovules few compared with the *Proriferi*, the latter seldom over 22 in number and mostly fewer. The remaining subsections are the monotypic *Horniani*, annual halophytes with a long active period, but perishing in the fall and becoming tumbleweeds; and the *Sparsiflori*, the significant nucleus of which is composed of species similar in all respects to the *Aridi* except that the pod is not or scarcely inflated and often semibilocular.

The history of sect. *Inflati* and its typification by *A. Douglasii* deserve comment. The section was proposed by Gray to accommodate all fifteen *Astragali* with inflated fruits known from North America up to 1863. This was only a fraction of those described to the present, but the section was nevertheless already heterogeneous in the extreme, embracing such disparate types as *A. (Inflati, sens. restr.) Douglasii*, *A. (Phaca) frigidus*, *A. (Densifolii) Menziesii*, and *A. (Megacarpis) megacarpus*. Jones (1923, p. 91, sequ.) reduced the scope of the section only by the exclusion of *A. frigidus*, otherwise maintaining all Gray's elements and introducing many new ones; his *Inflati*, divided in the key into series or subsections, number fifty, including *A. lentiginosus* and its many varieties. The section as circumscribed by Jones is almost equivalent to *Phaca* as Rydberg conceived it in America, if *A. lentiginosus* and other forms with partially bilocular fruits are excluded. Unfortunately Rydberg published no detailed revision of *Phaca* other than his summary, baldly presented exposition in *North American Flora*, but we have only to examine this to see that he recognized the great diversity in Jones's *Inflati*, dividing them into two subgenera, *Podocystis* and *Chartocystis*, according to the presence or absence of stipe, the latter being nearly coextensive with our *Inflati*, although containing many misplaced species. Analysis of the original *Inflati* shows that seven sections were represented by the fifteen species recognized by Gray. The largest group of four, which included *A. Wootoni* (as *A. triflorus*), *A. Geyeri*, *A. macrodon*, and *A. Douglasii*, forms the historic nucleus of the first and third subsections of our *Inflati*. Of the four *A. Douglasii*, the first described and most widely dispersed, is a reasonable choice of lectotypus.

Because of the overlapping of all diagnostic characters from one group of *Inflati* to another, it is not possible to construct a neat and also workable key to the subsections. In its place I present a panoramic synopsis of the section followed by a purely artificial key to the species.

Synopsis of Sect. INFLATI

*Subsect. INFLATI.—Perennials; *leaflets* of some leaves over 21; *racemes* over 10-flowered; *petals* ochroleucous, the banner 8–13 mm. long; *pod* sessile, inflated, unilocular; *ovules* 30–70.

A. Douglasii

var. *Parishii*

var. *perstrictus*

var. *glaberrimus* (leaflets 13–19; ovules 22–26)

A. macrodon

A. oocarpus (pod persistent)

A. Deanei (banner 12–15 mm. long)

**Subsect. PRORIFERI.—Perennials and biennials; *leaflets* of some leaves over 21; *racemes* over 10-flowered; *petals* purple; *pod* sessile, inflated, unilocular; *ovules* (8) 10–30.

A. gruinus (pedicels disjointing with pod)

A. Palmeri (flowers sometimes ochroleucous)

A. idrietorum (leaflets 11–23)

A. piscinus

- A. fastidius* (petals sometimes ochroleucous; pod elevated on a gynophore)
A. magdalenae
 var. *niveus*
 var. *Peirsonii* (leaflets few, the terminal one decurrent)

***Subsect. ARIDI.—Annuals and biennials, rarely perennant; *leaflets* 7–21; *racemes* 2–10-flowered; *petals* whitish or purple; *pod* sessile or raised on a short gynophore, usually much inflated, uni- or subunilocular; *ovules* 7–22.

- A. allochrous* (raceme 10–30-flowered)
A. Wootoni
 var. *Wootoni* (raceme up to 15-flowered)
 var. *Candollianus*
A. Thurberi (raceme 10–32-flowered)
A. Wardi (leaflets 17–23)
A. aquilonius (leaflets 15–23; ovules 27–39)
A. cerussatus
A. endopterus (ovules 28–30)
A. serpens (short gynophore present)
A. pubentissimus
A. pardalinus
A. sabulorum
A. nutans (gynophore present or absent; ovules 19–24)
A. Gilmani
A. insularis
 var. *quentinus*
 var. *Harwoodii*
A. Geyeri
 var. *triquetrus* (pod semibilocular)
A. aridus

****Subsect. SPARSIFLORI.—Annuals or perennials of short duration; *leaflets* 7–19; *racemes* 2–15-flowered; *petals* white (pink-veined); *pod* sessile or raised on a short gynophore, either bladdery-inflated and unilocular, or moderately inflated and uni- or subunilocular, or narrowly oblong-ellipsoid, not inflated, and subuni- to subbilocular; *ovules* 6–22

- A. Wetherilli* (pod inflated, unilocular)
A. sparsiflorus
 var. *sparsiflorus* (pod very small, not inflated, uni- or subunilocular)
 var. *majusculus* (pod narrowly ellipsoid, not inflated, subunilocular)
A. diaphanus (pod narrowly oblong-ellipsoid or ovoid, uni- or semibilocular)

*****Subsect. HORNIIANI.—Annuals of long duration, becoming tumble-weeds in fall, halophytes; *leaflets* 15–33; *racemes* 10–35-flowered, dense and headlike; *petals* whitish or lilac-tinged; *pod* sessile, bladdery, unilocular, tardily deciduous; *ovules* 11–17.

- A. Hornii*
 var. *minutiflorus*

Key to the Species of Sect. Inflati

1. Pod strictly unilocular, with no trace of septum even toward the base (2)
2. Racemes (1) 2–10-flowered (if slightly more in some racemes then follow either choice) (3)
3. Pod ascending from the raceme, not greatly inflated, 1–1.7 cm. long, 4.5–7 mm. wide, silky-canescens like the foliage; *flowers* very small, whitish or pink-tinged, the keel 3.6–5 mm. long; *ovules* 3–7; obligate annuals of low elevations in the Colorado Desert, s.-e. California, s.-w. Arizona, and immediately adjoining Mexico 284. *A. aridus*
3. Pod spreading or declined, glabrous, strigulose, or villous, not canescent; *ovules* (6) 7–28; in the range of *A. aridus* either the flowers slightly larger, or the pod villosulous (4)
4. Pod elevated on a well-developed gynophore (0.7) 1–2.5 mm. long, the valves strigulose or shortly villosulous; local (caulescent), perennial species of the Colorado Basin and mountains of centr. Utah (5)
5. Petals purple or greenish-purple; *pod* ovoid-ellipsoid, shortly or obscurely beaked, the valves brightly mottled; *herbage* loosely strigulose-pilosulous, the leaflets medially glabrescent above; mountains of centr. Utah, 7500 ft. upward 276. *A. serpens*

5. Petals whitish, $\pm$ pink-veined or -suffused; *pod* ovoid-acuminate, strongly beaked, the valves green or purple-speckled or -suffused but not mottled; *herbage* strigulose, the leaflets glabrous above; Grand River Valley, Colorado, below 6000 ft. 285. *A. Wetherilli*
4. Pod sessile on the conical or flat receptacle, the gynophore mostly 0, if present no longer than wide, or if present and over 1 mm. long the plants either slender annuals of the Mohave Desert in California, or subacaulescent species of the Colorado Basin (the pod then hirsute with lustrous, pustular-based hairs) (6)
6. Pod villous or hirsute, the hairs 0.7–2.2 mm. long (7)
 7. Ovules 4–9; slender, caulescent perennials, villous-hirsute throughout with hairs up to 1–1.6 mm. long, the stems prostrate and forming loosely woven mats; n.-e. California and adjacent Nevada; cf. *A. (Monoenses) Pulsiferae*.
 7. Ovules (9) 10–28; annuals or perennials of other range, if prostrate then annual (8)
 8. Low, tufted, acaulescent or subacaulescent perennials (of the Colorado Basin), the stems not over 3 cm. long (or if longer then the flowers relatively large, the banner over 12 mm., the keel over 9 mm. long); *pubescence* of the herbage subappressed, that of the pod hirsute, the hairs minutely bulbous-based; *ovules* (16) 18–28; cf. *A. (Desperati) desperatus*.
 8. Caulescent, usually coarser plants, the stems short only in young or starveling plants and the root then very slender, truly or apparently annual; *flowers* always small, the banner less than 12 mm., the keel less than 9 mm. long; *pubescence* of the pod composed of filiform hairs; *ovules* 9–19 (9)
 9. Biennial or perennial of short duration (sometimes flowering the first season); *flowers* relatively large, the banner (7.5) 8.8–11.7 mm., the keel (6.2) 7.3–8.7 mm. long; *ripe pod* thinly papery, the hairs (0.8) 1.2–2.2 mm. long; Green River and Colorado Basins, rare s. of Tavaputs Escarpment in Utah 277. *A. pubentissimus*
 9. Annual (exceptionally persisting over winter near sea level in the Colorado Desert); *flowers* very small, the banner 5.2–7.2 mm., the keel 5–6.5 mm. long; *ripe pod* stiffly papery or somewhat leathery, the hairs shorter, 0.6–1 mm. long; s.-e. Utah and n.-w. New Mexico to s.-centr. Nevada and n.-w. Sonora 279. *A. sabulorum*
6. Pod glabrous or strigulose, if loosely strigulose the hairs not over 0.7 mm. long (10)
 10. Flowers relatively large, the calyx 6.7–7.8 (the tube over 3.4) mm. long; *banner* 9.5–11 mm., the keel 7.8–8.9 mm. long; *petals* ochroleucous; *pod* large, 2.5–4 cm. long; *ovules* 27–39; upper Salmon River in e.-centr. Idaho 273. *A. aquilonius*
 10. Flowers mostly smaller, the calyx not over 6.6 mm. (if over 6 mm. its tube not over 3.2 mm.) long; *banner* 5.2–10 mm., the keel 3.6–7.2 mm. long, if the banner over 8.5 mm. long then purple; *pod* mostly smaller, but if as large then the ovules not over 26 (except in *A. endopterus* of Arizona with 7–11-foliolate leaves); range otherwise (11)
 11. Ovary and pod glabrous; *leaflets* 17–23, small (mostly 3–8 mm. long) and distant, thinly ciliate; Sevier Valley and Henry Mountains, Utah 272. *A. Wardi*
 11. Ovary and pod pubescent; *leaflets* usually fewer, if as many longer, or more densely pubescent, or both; range otherwise (12)
 12. Pod loosely strigulose, the hairs spreading, incumbent, or curly (13)
 13. Pod thinly papery, bladdery, the walls diaphanous; local species of the Panamint Mountains in s.-e. California, or of the s. Rocky Mountains in Colorado, or of the Cascade Range in n.-e. California and e. Washington (14)
 14. Leaflets 9–13; *ovules* 4–12; California and Washington (15)
 15. Calyx-teeth 0.7–1.3 mm. long; *petals* purple; *ovules* 8–12; Panamint Mountains, Death Valley, California 281. *A. Gilmani*
 15. Calyx-teeth 1.4–3.6 mm. long; *petals* whitish with pink veins; *ovules* 4–9; cf. *A. (Monoenses) Pulsiferae* var. *Suksdorfii* of n.-e. California and Washington.

14. Leaflets 13–21; ovules 18–26; s. Colorado 274. *A. cerussatus*
13. Pod firmly papery, the walls not or scarcely diaphanous, turgid but not bladdery (or if bladdery, very local in e. Utah); widely dispersed over the intermountain region but nowhere sympatric with the last (16)
16. Pod not or scarcely inflated, mostly 9–17 mm. long, 5–8 mm. in diameter, rarely longer, strongly oblique and lunately incurved or hooked; ovules 10–19; widely dispersed from e. Utah and n.-w. New Mexico to Sonora 279. *A. sabulorum*
16. Pod inflated, bladdery but rather firmly so, mostly 1.5–2 cm. long, 8–11 mm. in diameter, ovoid-ellipsoid and only a little oblique, not strongly incurved; ovules 20–28; local in s.-e. Utah 278. *A. pardalinus*
12. Pod truly strigulose, the hairs straight and appressed (17)
17. Pod narrow, little or not inflated, 6–20 mm. long, 2.7–4 mm. in diameter (18)
18. Caulescent, the stems 7–33 cm. long; flowers very small, the calyx 3–4.3 mm., the banner 5.5–8 mm. long; e. slope of the Colorado Rocky Mountains 286. *A. sparsiflorus*
18. Acaulescent or nearly so, the stems 0–3 (7) cm. long; flowers a little larger, the calyx 5–5.5 mm., the banner 9.5–11 mm. long; Mesa Verde, s.-w. Colorado; cf. *A. (Desperati) deterior*.
17. Pod $\pm$ strongly inflated, bladdery, 5–17 mm. in diameter (19)
19. Leaflets 7–11, distant, narrow; pod subsymmetrically ovoid-ellipsoid, 2–2.7 cm. long, 1.1–1.7 cm. in diameter, the funicular flange very broad, 3–3.5 mm. wide; flowers small, whitish, the banner $\pm$ 6–6.3 mm. long; ovules 28–30; local on the lower Little Colorado, Coconino County, Arizona 275. *A. endopterus*
19. Leaflets variable in number, but if no more than 11 in any mature leaves then either the flowers larger, or purple, or the pod either strongly asymmetric and incurved, or narrower; pod sometimes similar in size and outline, but the funicular flange then not over 2.5 mm. wide, usually much less; ovules 7–24 (20)
20. Pod subsymmetrically ovoid-ellipsoid or subglobose, the sutures subequally convex or the ventral one only a little less so than the dorsal one, the beak short and obscure; calyx-teeth 2–3.5 mm. long; widespread from w. Texas to n. New Mexico, w. across Arizona to extreme e. Mohave Desert in California, s. to Puebla; flowers whitish w. of New Mexico 270. *A. Wooloni*
20. Pod strongly oblique in profile and prominently beaked (except in *A. insularis* var. *quentinus* of coastal Baja California); calyx-teeth 0.7–2 mm. long; if of the Mohave Desert the petals purple and leaflets 7–13 (21)
21. Plants of John Day Valley, e. Oregon; leaflets mostly of an ovate or obovate-obcordate type. Pod of very thin texture, the valves diaphanous 287. *A. diaphanus*
21. Plants of the Great Basin and interior deserts (s.-e. Oregon to n.-w. Sonora, thence to coastal Baja California, e. to Wyoming); leaflets mostly of an oblong-elliptic to linear type (22)
22. Petals whitish (exceptionally purple in centr. Nevada); species widespread n.-ward, reaching s. to s. Nevada and adjoining Arizona and Mono County, California; pod green becoming stramineous 283. *A. Geyeri*
22. Petals pink- or magenta-purple, drying bluish; Panamint Mountains and Mohave Desert, California, to adjacent Arizona, n.-w. Sonora, and Baja California; pod often purple-speckled or -tinged (23)
23. Leaflets 7–13; funicular flange within the pod well developed, 1–2.5 mm. wide; Panamint Mountains and e. Mohave Desert (s. to the Chuckwalla Moun-

- tains in Riverside County), California, the ovules at least 19 and the banner 7.8–10.4 mm. long outside the Panamints (24)
24. Banner 7.8–10 mm. long; *ovules* 19–24; e. Mohave Desert below 6500 ft., San Bernardino and extreme n. Riverside Counties 280. *A. nutans*
24. Banner 6.1–8 mm. long; *ovules* 8–12; Panamint Mountains, Inyo County, 6500–10,000 ft. 281. *A. Gilmani*
23. Leaflets (7) 11–19 (21); *funicular flange* 0.2–1.5 mm. wide; *ovules* 7–14; *banner* 5.2–7.4 mm. long; Colorado Desert, California (n. to the Chuckwalla Mountains) and w. Arizona, to s.-w. Sonora and Baja California 282. *A. insularis*
2. Racemes all, or all but some subterminal and obviously depauperate ones, over 10-flowered (25)
25. Pod elevated on a pubescent gynophore 3–8.5 mm. long; Baja California 267. *A. fastidius*
25. Pod sessile on a flat or conical receptacle, the gynophore, if at all developed, no longer than the calycine disc and not over 1 mm. long (26)
26. Plants silvery- or satiny-pubescent throughout; coastal dunes of Baja California, and around the head of the Gulf of California to w. Sonora, one var. extending n. to desert dunes in the s. Colorado Desert in Alta California, but the terminal leaflet then confluent with the rachis 268. *A. magdalenae*
26. Plants variably pubescent, green, cinereous, or sometimes silvery, but then not coastal, and if of the deserts then the terminal leaflet jointed (27)
27. Flowers and pods aggregated into oblong or subglobose heads; plants of alkaline flats and seeps in scattered stations from n.-w. Nevada to San Joaquin Valley and the edge of the Mohave Desert in California, and Baja California. Coarse annuals, of long duration, becoming tumbleweeds in fall 288. *A. Hornii*
27. Flowers and pods $\pm$ loosely racemose; not halophytes, and if annual of short duration (28)
28. Ovary and pod glabrous; *flowers* very small, the banner 5.2–7.4 mm., the keel 3.9–4.6 mm. long; Sevier Valley and Henry Mountains, Utah 272. *A. Wardi*
28. Ovary and pod pubescent or, if glabrous, the flowers a little larger, the banner and keel at least 9 mm. long, and plants of s. California or Baja California (29)
29. Herbage and pod villosulous or hirsute with spreading or loosely incumbent hairs (30)
30. Leaflets 7–21; plants of interior w. United States and Baja California; *ovules* 7–18 (31)
31. Racemes 10–35-flowered; *pod* loosely strigulose or hirsutulous with hairs much less than 1 mm. long; Baja California 264. *A. prorifer*
31. Racemes less than 15-flowered; *pod* hirsute with lustrous hairs well over 1 mm. long; Colorado and Green River Basins 277. *A. pubentissimus*
30. Leaflets 17–29; plants of the s. Coast Ranges, California; *ovules* 29–52. (Calyx-teeth 2.5–4.3 mm. long; if led here by plants of interior s. California with calyx-teeth not over 2 mm. long, cf. *A. Douglasii* var. *Parishii*) 259. *A. macrodon*
29. Herbage strigulose with appressed or subappressed hairs, or subglabrous (32)
32. Pod very small, subglobose, scarcely or very shortly beaked, 6–13 mm. long, 6–10 mm. in diameter; *ovules* 8–11; s. Arizona and s.-w. New Mexico, and closely adjoining Mexico 271. *A. Thurberi*
32. Pod larger, mostly 1.5–4 cm. long, if shorter then strongly beaked, the beak $\frac{1}{3}$ – $\frac{1}{2}$ as long as the body and obliquely ovoid or half-ovoid, and range otherwise (33)
33. Pod firmly attached to the receptacle, falling with the disjointing pedicel; *flowers* purple; Sierra San Pedro Mártir, Baja Cali-

- fornia, 5000–9500 ft.; *ovules* 24–26 262. *A. gruinus*
33. Pod readily deciduous from the receptacle (except in *A. oocarpus*, with ochroleucous flowers and 44–58 *ovules*), the fertile pedicels persistent (except in *A. piscinus*, coastal in centr. Baja California); if of n. Baja California and at the same time purple-flowered (*A. Palmeri*; *A. idrietorum*), then the *ovules* only 8–17 and below 5500 ft.
34. Leaflets 25–41; *keel-blades* shorter than or equaling the claws; *pod* deciduous, greatly inflated and papery, strongly oblique in profile, 2.3–5 cm. long; San Luis Obispo County, California, s. to extreme n. Baja California; cf. *A. (Densifolii) pomonensis*.
34. Leaflets 25 or less in the range given (if more, in *A. oocarpus* of interior San Diego County, California, then the *pod* persistent and the *keel-blades* longer than the claws) (35)
35. Racemes 20–60-flowered; *petals* ochroleucous, the banner fleshy-thickened (drying brownish), rarely purplish-tinged; *ovules* 44–58; *leaflets* leathery, 19–35; *pod* inflated but of stiff texture, ascending and persistent on the receptacle until dehiscence; tall leafy plants of the mountains of interior San Diego County, California 260. *A. oocarpus*
35. Racemes 10–30-flowered, or if up to 40-flowered the *petals* usually bright purple and *ovules* not over 40 (over 40 only in *A. Douglasii*); *leaflets* membranous, either not over 21, or if up to 29 the *pod* of thinly papery texture; *pod* deciduous (36)
36. Slender annuals of John Day Valley and lower Columbia River in e. Oregon and adjoining Washington 287. *A. diaphanus*
36. Biennials (sometimes precociously flowering) and perennials, of California and Baja California, to Texas and Mexico (37)
37. Pod subsymmetrically ovoid, ovoid-ellipsoid, or subglobose, the sutures subequally convex as seen in profile and the beak very short and obscure, not well differentiated from the body; widespread from e. Mohave Desert, California, to w. Texas and Mexico 270. *A. Wootoni*
37. Pod oblique in profile, half-ovoid or -ellipsoid, the ventral suture straight, concave, or less strongly convex than the dorsal one, the beak strongly developed and clearly differentiated from the body (38)
38. Ovary and pod glabrous; var. *glaberrimus* of 258. *A. Douglasii*
38. Ovary and pod pubescent (39)
39. Flowers ochroleucous or greenish-white, rarely tinged with dull purple; cismontane California, extending to the edge of the s. Mohave and Colorado Deserts and s. into extreme n. Baja California (40)
40. Pod 2.5–6 cm. long; *ovules* 42–71; widespread, but approaching the next in San Diego County only in the higher interior mountains (mostly over 4000 ft.) and the banner there 8–12 mm. long 258. *A. Douglasii*
40. Pod 1.6–2.8 cm. long; *ovules* 27–40; either in desert mountains around head of Coachella Valley and vicinity below 3000 ft., or in w. San Diego County, but there at $\pm$ 1000 ft. and the banner mostly over 12 mm. long (41)
41. Leaflets mostly 21–29; *banner* mostly 12–15 mm. long (rarely shorter); *keel* 8–10.5 mm. long; cismontane San Diego County, $\pm$ 800–1000 ft. 261. *A. Deanei*

41. Leaflets 11-21; *banner* 7-10.3 mm. long; *keel* 6.2-8.8 mm. long; desert mountains around head of Coachella Valley; ochroleucous-flowered forma of 263. *A. Palmeri*
39. Flowers pink-purple, drying bluish; desert slope of the interior mountains of s. California, to n. Baja California and w. Texas (42)
42. Pod mostly (2) 2.5-4 cm. long; *fertile pedicels* persistent; Arizona to w. Texas 269. *A. allochrous*
42. Pod mostly 0.9-2.3 cm. long, if longer the pedicels deciduous; s. California and Baja California (43)
43. Ovules 8-12; *pod* extremely thin-walled, the valves subdiaphanous when ripe; Baja California deserts, lat. 29-30° N 265. *A. idrietorum*
43. Ovules 12-31; *pod* papery, but the valves firmer, not so transparent; either along the w. edge of the Colorado Desert in California to the n. end of San Pedro Mártir Mountains near lat. 30° N. or on the w. coast of Baja California in lat. $\pm$ 28° N. (44)
44. Pod mostly 5-15 mm. long; *fertile pedicels* persistent; *leaflets* 11-21; mostly above 1000 ft. and n.-ward from San Pedro Mártir 263. *A. Palmeri*
44. Pod mostly 2-3 cm. long; *fertile pedicels* disjuncting with the fruit; *leaflets* 17-25; Pacific coast of Baja California at Lagoon Head 266. *A. piscinus*
1. Pod subuni- to subbilocular, a septum always present although often narrow, sometimes absent from the distal half of the suture but present at its base (45)
45. Racemes 15-25-flowered; *leaflets* 21-29; *ovules* 29-40; cismontane s. California (San Diego County) 261. *A. Deanei*
45. Racemes less than 15-flowered; *leaflets* 5-19 (21); *ovules* 6-28; s. Rocky Mountains and intermountain United States (46)
46. Pod hirsute with long, spreading, lustrous, minutely bulbous-based hairs; Colorado Basin; cf. *A. (Desperati) desperatus*.
46. Pod strigulose, the hairs appressed or subappressed, filiform (47)
47. Herbage villosulous; *ovules* 18-22; *pod* bladdery-inflated; s. Rocky Mountains in Colorado 274. *A. cerussatus*
47. Herbage strigulose; *ovules* 6-15; if of the s. Rocky Mountains the pod scarcely or not inflated (48)
48. Leaflets (5) 7-9; *racemes* 2-8-flowered; *pod* inflated, 6-10 mm. in diameter; *Larrea* deserts of s. Nevada and n.-w. Arizona; var. *triquetrus* of 283. *A. Geyeri*
48. Leaflets 9-19, or racemes 7-15-flowered; *pod* little or not inflated, 2.7-6 mm. in diameter; either e. slope of Colorado Rocky Mountains or interior Oregon and Washington (49)
49. Pod papery but hardly transparent; Colorado, on the Platte and Arkansas Rivers 286. *A. sparsiflorus*
49. Pod papery-membranous, becoming transparent; John Day system in e. Oregon and adjoining lower Columbia Valley in Washington 287. *A. diaphanus*

LXIX (i). Subsectio INFLATI

Perennials; *leaflets* of some leaves over 21 (less only in *A. Douglasii* var. *glaberrimus*); *racemes* over 10-flowered; *petals* ochroleucous, little or poorly graduated, or normally graduated in *A. Deanei*; *pod* sessile, greatly inflated, unilocular (or essentially so); *ovules* 30-70 (22-26 only in *A. Douglasii* var. *glaberrimus*).
—Spp. 4, cismontane California and northern Baja California.

ASTRAGALUS sect. *INFLATI* Gray in Proc. Amer. Acad. 6: 213. 1864, sensu hic valde restricto.—Sp. lectotypica: *A. Douglasii* (T. & G.) Gray.

Astragalus sect. *Oocarpus* Gray in op. cit. 213. 1864, sens. restr.—Sp. lectotypica: *A. oocarpus* Gray.—*Phaca* subgen. *Chartocystis* sect. *Oocarpae* (Gray) Rydb. in N. Amer. Fl. 24: 342. 1929.

Astragalus sect. *Inflati* subsect. *Macrodon* Jones, Rev. Astrag. 95, in clave. 1923.—Sp. lectotypica: *A. macrodon* H. & A.

Phaca subgen. *Chartocystis* sect. *Douglasianae* Rydb. in N. Amer. Fl. 24: 344, sens. restr. 1929.—Sp. lectotypica: *P. Douglasii* T. & G. = *A. Douglasii* (T. & G.) Gray.

The genuine *Inflati* are (with possible exceptions in *A. Deanei* and *A. Douglasii* var. *glaberrimus*) soundly perennial astragali, differing from nearly all other members of the section in their comparatively numerous, generally little graduated, and strongly incurved petals combined with relatively many leaflets and many ovules. The subsection is nearly confined to the Californian floristic province, only *A. Douglasii* var. *glaberrimus*, which is for several reasons anomalous in its group, extending shortly southward from the provincial border in Lower California. The center of diversity of the subsection lies in San Diego County, California, to which two of the four species and one variety of a third are endemic. The stiff-walled, although definitely inflated pod of *A. oocarpus*, which persists until dehiscence on thickened pedicels, is a notable exception among the normally piptoloboid *Inflati*.

258. ASTRAGALUS DOUGLASII

Perennial, with a taproot and knotty root-crown or shortly forking caudex at soil-level, variable in stature, very thinly to quite densely strigulose (or exceptionally villosulous) with fine, straight, appressed or subappressed (subsINUOUS and spreading) hairs up to 0.3–0.6 mm. long, the stems often glabrous or nearly so proximally, the herbage deep green, yellowish-green, greenish-cinereous or rarely subcanescent, the leaflets glabrous on both sides, pubescent only beneath, or pubescent on both sides and then sometimes a trifle more densely so above than beneath; *stems* commonly numerous, prostrate or decumbent with ascending tips, in one variety erect, 2–10 dm. long, simple, or branched or spurred at 1–5 (7) nodes preceding the first peduncle; *stipules* 1.5–6.5 mm. long, the small lower ones early becoming papery and brownish, the rest green, firm or submembranous, deltoid, deltoid- or lance-acuminate, decurrent around half (the lowest often more than half) the stem's circumference, thinly ciliate and sometimes also beset with a few minute processes, the blades of the upper ones squarrose or deflexed; *leaves* 5–16 (18) cm. long, the lower ones slender-petioled, the upper very shortly so or subsessile, with (7) 11–25 ovate, obovate, oblong-elliptic, oblanceolate or linear-oblong, mostly obtuse or retuse, sometimes truncate and mucronulate, rarely subacute leaflets 5–25 (30) mm. long, mostly flat but dorsally carinate by the midrib; *peduncles* 2.5–13 cm. long; *racemes* 8–35-flowered, loose or very early becoming so, the flowers at full anthesis subhorizontal or ascending at a wide angle, the axis much or little elongating, (2) 2.5–12 (17) cm. long in fruit; *bracts* membranous, lanceolate or ovate-acuminate, 1–3 mm. long; *pedicels* ascending at a wide angle or in age sometimes divaricate or arched outward, at first slender and 0.8–3 mm., in fruit more or less thickened and 1.3–4 (4.8) mm. long, persistent; *calyx* 4–7.4 (8) mm. long, thinly to quite densely strigulose with white, largely white, or rarely with nearly all black hairs, the campanulate or ovoid-campanulate tube (2.5) 2.9–4.3 mm. long, the subulate or triangular teeth 0.9–3.4 (4) mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* ochroleucous, yellowish, or greenish-white, immaculate, all strongly incurved, little or sometimes irregularly graduated; *banner* abruptly recurved through (60) 70–90°, (6.4) 7.8–13 mm. long, the shortly cuneate claw abruptly expanded into a broadly ovate, rhombic-ovate or subquadrately orbicular blade 6–10.2 mm. wide, shallowly notched; *wings* 1.5 mm. shorter to 0.4 mm. (exceptionally 1.5 mm.) longer than the banner, the narrowly oblong-oblanceolate, -elliptic, or obliquely half-obovate,

obtuse or shallowly emarginate blades both incurved, but one of them commonly more abruptly so than the other, the inner margins of both usually infolded toward the keel; *keel* (6.2) 7.1–10.8 mm. long, 0–1.3 mm. shorter than the wings, the lunately triangular or half-elliptic blades (4.3) 4.6–6.4 mm. long, strongly incurved through 90–100° to the narrowly deltoid or triangular, subacute, often slightly porrect apex; *anthers* 0.55–0.8 mm. long; *pod* spreading or when humistrate loosely ascending, sessile on the slightly elevated receptacle, obliquely ovoid, half-ovoid, or half-ellipsoid, bladdery-inflated, 2.5–6 cm. long, 1.2–3.2 (or when pressed apparently up to 3.5) cm. in diameter, rounded at base, contracted distally into a laterally flattened, deltoid, nearly erect or strongly incurved beak (2) 4–8 mm. long, otherwise a little obcompressed, flattened or openly sulcate ventrally, the ventral suture straight or low-convex, the dorsal one strongly gibbous-convex, the thin, pale green, sometimes purple-tinged or -speckled, strigulose, glabrescent, or truly glabrous valves becoming stramineous, papery, more or less lustrous, not inflexed, the funicular flange 0.3–2.5 mm. wide; *dehiscence* apical, after falling, the beak gaping to release the seeds; *ovules* mostly 50–70, in one variety only 22–36; *seeds* brown, reddish-brown, or ochraceous, pitted and wrinkled, or nearly smooth, dull, 2.3–3.1 mm. long.

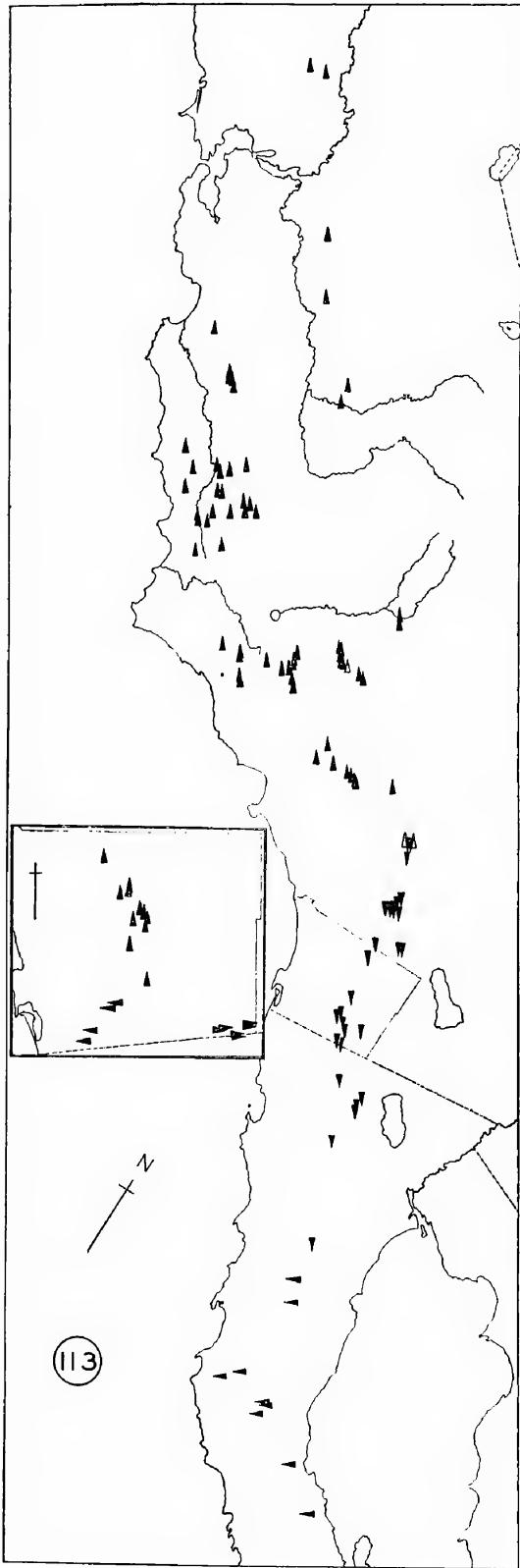
The Douglas milk-vetch is the prototype of a taxonomically difficult group of soundly perennial *Inflati* distinguished by racemes of comparatively numerous (almost always over 10 and up to about 60) flowers with petals strongly recurved and poorly or sometimes irregularly graduated. It is polymorphic and variable, and it would be difficult and moreover of little practical usefulness to emphasize differential characters of the species as a whole, although an attempt is made in the following pages to do so for each of its four varieties. The center of variation in the species lies in interior southern California and adjoining Mexico and coincides with the center of speciation in the group.

Key to the Varieties of *A. Douglasii*

1. Ovary and pod strigulose, the pod rarely glabrate; *ovules* 42–71; *racemes* mostly 15–30-flowered, the flowers fewer only in late, depauperate racemes; widespread from central California to extreme n. Baja California, about lat. 32° 50' to 38° 50' N. Calyx-teeth variable in length, but rarely over 1.6 mm. long s. of the San Bernardino Mountains (2)
2. Calyx uniformly pubescent, the teeth subulate or triangular-subulate, 1.4–3 mm. long; Los Angeles and San Bernardino Counties n.-ward 258a. var. *Douglasii*
2. Calyx-tube thinly pubescent, the teeth broadly triangular, deltoid, or subulate from a broadly triangular base, mostly 0.7–1.3 mm., rarely up to 1.9 (2.2) mm. long, the sinuses between them broad and prominently outlined with a band of closely set white hairs; San Bernardino County, s.-ward (3)
3. Stems diffuse or weakly assurgent, mostly 2–6 dm. long; *peduncles* incurved-ascending, the fruits commonly humistrate; *pod* mostly rather small, 2.5–4 (5) cm. long; San Bernardino Co. s. into n. Baja California 258b. var. *Parishii*
3. Stems erect or stiffly ascending, 4–10 dm. long; *peduncles* erect even in fruit; *pod* large, (3.5) 4–6 cm. long; local near the international boundary in s.-e. San Diego County 258c. var. *perstrictus*
1. Ovary and pod glabrous; *ovules* 22–36; *racemes* (6) 8–15 (17)-flowered; *calyx-teeth* subulate or lance-subulate, 1.5–4 mm. long; San Pedro Mártir Mountains and Viscaíno Desert, Baja California 258d. var. *glaberrimus*

258a. *ASTRAGALUS DOUGLASHII* var. *DOUGLASHII*

Stems decumbent with ascending tips, trailing, or weakly assurgent, (1.5) 2–6 (7) dm. long; *vesture* variable in density and distribution, appressed, the herbage nearly glabrous to cinereous, the leaflets either glabrous on both sides, on above only, or pubescent on both sides; *leaflets* (11) 15–25, ovate, obovate, oblong-elliptic, oblanceolate, or linear-oblong, mostly obtuse or retuse, sometimes truncate and mucronulate or (especially in some upper leaves) subacute, 5–25 (30) mm. long; *peduncles* 2.5–9 cm. long; *racemes* (10) 15–30 (35)-



flowered, the axis (2) 2.5–12 (17) cm. long in fruit; *calyx* (4.7) 4.9–6.6 mm. long, either black- or white-hairy, the tube (2.5) 2.9–4.3 mm. long, (2.3) 2.5–3.4 mm. in diameter, the subulate or rarely triangular-subulate teeth 1.4–2.6 mm. long; *banner* (6.4) 7.8–13 mm. long, (5.8) 6.8–10.2 mm. wide; *wings* (0.9 mm. shorter to 0.4, rarely 1.5 mm. longer than the banner) (6.2) 7.6–12.1 mm. long, the claws (2.2) 2.6–4.9 mm., the blades (4.4) 5.4–8.1 mm. long, 2–3 mm. wide; *keel* (0–1.3 mm. shorter than the wings) (6.2) 7.1–10.8 mm. long, the claws (2.2) 2.4–4.7 mm., the blades (4.3) 4.6–6.4 mm. long, (2.1) 2.3–3.2 mm. wide; *pod* 2.5–6 cm. long, 1.2–3.2 (or when pressed to 3.5) cm. in diameter, thinly strigulose, rarely glabrate in age, the funicular flange 0.7–1.8 mm. wide; *ovules* (46) 51–71 (average 55).—Collections: 67 (x); representative: *Stinchfield* 349 (NY); *Eastwood* 6921 (CAS, NY); *Eastwood & Howell* 2376 (CAS, WS); *Jones* (from Tehachapi) in 1903 (CAS, NY, POM, WS); *Barneby* 11,291 (CAS, RSA); *Ripley & Barneby* 5857 (CAS, RSA); *C. B. Wolf* 4365 (CAS, WS); *Munz* 7696 (NY, POM); *Parish* 3378 (CAS, NY).

Open grassy hills, rolling adobe plains and valley floors, stony creek beds, openings or flats in digger pine and live oak woodland, widespread and locally abundant, mostly between 600 and 5000 feet, in the inner South Coast Ranges of California, extending at low elevations (down to 160 feet) and less commonly north to the central Great Valley in Yolo and San Joaquin Counties and south into the mountains of interior Santa Barbara and Ventura Counties and around the head of San Joaquin Valley; locally plentiful in yucca-juniper forest at $\pm$ 3250–3550 feet at the edge of the Mohave Desert in Kern and Los Angeles Counties; thence south and east and ascending into yellow pine forest up to 6800 feet along the north slope of the San Gabriel and San Bernardino Mountains, there passing into var. *Parishii*.—Map No. 113.—April to July, sometimes into October in the mountains.

ASTRAGALUS DOUGLASII (T. & G.) Gray in Proc. Amer. Acad. 6: 215. 1864, based on *Phaca Douglasii* (David Douglas. 1798–1834, pioneer plant collector in California and the Northwest) T. & G., Fl. N. Amer. 1: 346. 1838.—“California, *Douglas*.”—Holotypus, NY (herb. Torr.)! isotypi, BM, G, GH (fragm.), K (3 sheets), OXF!—*Tragacantha Douglasii* (T. & G.) O. Kze., Rev. Gen. 944. 1891.

Phaca tejonensis (of Fort Tejon) Jones in Proc. Calif. Acad. Sci. II, 5: 644. 1895 (“*Tejonensis*”).—“Pringle, Mojave desert, May 13, 1882, on hills bordering the desert. Tehachapi, Cal., June 1884, hills near Tejon Pass, Cal., May 13, 1882...”—Holotypus, the last cited, collected by C. G. Pringle. US!—*A. Douglasii* var. *tejonensis* (Jones) Jones, Contrib. West. Bot. 10: 61. 1902. *Phaca tejonensis* (Jones) A. Hell., Muhlenbergia 2: 85. 1905.

Phaca vallicola (dwelling in Bear Valley) Rydb. in N. Amer. Fl. 24: 343. 1929.—“Type collected in Bear Valley, San Bernardino Mountains, 1886, S. B. & W. F. Parish 1407 D...”—Holotypus, NY!

Phaca megalophysa (with large bladders) Rydb. in op. cit. 244. 1929.—“Type collected in Swarthout Canyon, San Antonio Mountains, H. M. Hall 1531 (Gray Herb.).”—Holotypus, collected at 6862 ft., June 3–6, 1900, GH!—*Astragalus megalophysus* (Rydb.) Munz & McB. ex Munz in Bull. S. Calif. Acad. Sci. 31: 65. 1932 (“*megalophysa*”).

The Douglas milk-vetch is the only small-flowered astragalus with pods at once greatly swollen and sessile in the calyx at all common in the California Coast Ranges between the lower Sacramento River and Santa Barbara. The related *A. macrodon* is found in the same range but is only rarely met with and is easily recognized by its villous leaves and fruits. Near the southern limit of its range var. *Douglasii* approaches the superficially similar *A. pomonensis* and the two species are often confused. The differential characters have been mentioned in the sectional key and stressed again under the heading of *A. pomonensis*.

Map No. 113. Parts of California and Baja California, from the lower Sacramento Valley south to the Viscaïno Desert. Range of *A. Douglasii*: $\blacktriangle$ var. *Douglasii* ($\triangle$ transitional to var. *Parishii*); $\blacktriangledown$ var. *Parishii*; $\blacklozenge$ var. *glaberrimus*. Inset, San Diego County, California. Range of $\blacklozenge$ *A. Douglasii* var. *perstrictus*; of $\blacktriangle$ *A. oocarpus*; and of $\blacklozenge$ *A. Deanei*.

The var. *Douglasii* varies a good deal in the size of the fruits, which commonly fluctuate in length between approximately 3 and 4.5 cm. Extremely large pods, 5–6 cm. in length and proportionately inflated, are of sporadic occurrence, sometimes in a colony of otherwise like plants, and have been found not only in the San Bernardino and San Gabriel Ranges, but here and there northward through the inner Coast Ranges as far as San Benito County. Such pods are in no way correlated with a particular color of the calyx-hairs, and thus *Phaca megalophysa* represents only one of several commonplace individual variants. The case of *Phaca vallicola* is similar. It was keyed out by Rydberg among the *Oocarpae* rather than the *Douglasianae*, and therefore should have, by definition, deltoid calyx-teeth one fourth to one third as long as the tube. However the teeth in the typus reach a length of 1.5 mm., with tube only 2.5–3 mm. long, a ratio of tube to teeth by no means unusual in var. *Douglasii* as here defined.

When Jones described *A. tejonensis*, he was evidently unfamiliar with the genuine *A. Douglasii*. In his Revision (1923, p. 113) he maintained it as a variety supposed to range northward from the San Bernardino Mountains, whereas genuine *A. Douglasii* was thought to extend southward from the head of San Joaquin Valley into Lower California. Although the type-locality of *Phaca Douglasii* is not precisely known, we can be sure that it was not in southern California, but very likely in Monterey or San Benito County.

The Douglas milk-vetch is often associated in the arid inner South Coast Ranges with *A. asymmetricus* or *A. oxyphysus*, both feared as locoweeds. It has a reputation as being toxic itself, although this is apparently less well deserved. In San Benito County it has been identified as poisonous to bees (*Vansell in 1936, CAS*).

258b. ASTRAGALUS DOUGLASII var. PARISHII

Habit and stature of var. *Douglasii*, very variable in pubescence, the herbage green or cinereous, the leaflets glabrous on both sides, strigulose beneath, or thinly to densely strigulose or rarely villosulous on both sides, the hairs commonly straight and appressed, sometimes loosely ascending and more or less sinuous; *calyx* 4–6 mm. long, the tube 2.6–4.1 mm. long, 2.5–3.6 mm. in diameter, the teeth 0.7–1.9 (2.2) mm. long; *banner* 8.1–12 mm. long, 6–9 mm. wide; *wings* (0.4 mm. longer to 1.4 mm. shorter than the banner) 7.9–10.7 mm. long, the claws 2.6–4 mm., the blades 5.9–7.4 mm. long, 1.9–3.3 mm. wide; *keel* (as long or up to 1.3 mm. shorter than the wings) 7.8–9.6 mm. long, the claws 2.8–4.3 mm., the blades 5–6 mm. long, 2.6–3 mm. wide; *pod* mostly 2.5–4, rarely up to 5 cm. long, the funicular flange 1–2.5 mm. wide, the valves strigulose; *ovules* 42–62 (76, average about 55).—Collections: 36 (i); representative: *Clokey 5267* (NY, TEX, WS); *Raven 9659* (CAS, RSA); *Balls 13,482* (CAS); *Munz 15,143* (CAS, POM); *Harbison 44,800* (RSA, SD).

Gravelly flats and openings in pine or oak forest, 4000–7700 feet, locally plentiful and rather common in the mountains of interior southern California, from the San Bernardino south through the San Jacinto and Santa Rosa to the Cuyamaca Mountains and south into extreme northern Baja California.—Map No. 113.—May to August, occasionally into October.

ASTRAGALUS DOUGLASII var. PARISHII (Gray) Jones, Contrib. West. Bot. 8: 6. 1898, based on *A. Parishii* (Samuel Bonsall Parish, 1838–1928, pioneer botanist in s. California) Gray in Proc. Amer. Acad. 19: 75. 1883.—“Common in San Bernardino Co., S. B. & W. F. Parish.”—Lectotypus, *Parish 1407*, GH! isotypi (*Parish Bros.*), from San Jacinto Mountain, DS (herb. Parish.), S. B. Parish in June, 1882, US! paratypi, *Parish 402, 605*, GH!—*Phaca Parishii* (Gray) Rydb. in N. Amer. Fl. 24: 344. 1929.

Phaca pseudoocarpa (simulating *A. oocarpus*) Rydb. in N. Amer. Fl. 24: 343. 1929.—“Type collected in the Cuiamaca Mountains, southern California, 1875, *Palmer 68*...”—Holotypus, NY!

Phaca topoensis (of *Topo* = Cantillas Canyon) Rydb., l.c. 1929.—“Type collected at *Topo*, Lower California, October, 1882, *Orcutt 621* (Gray Herb.).”—Holotypus, GH!

The present variety is poorly characterized, as already pointed out by Jepson who maintained it (1936, p. 351) on the combined basis of a banner relatively short and broad in relation to the wings and a robust habit of growth. Applying these standards of comparison Jepson traced var. *Douglasii* south to the border of Baja California, for a relatively long banner and slender growth-habit coincide here and there through the length of the species-range.

The calycine characters stressed in the foregoing key serve better to divide *A. Douglasii* into geographically separated races. In the San Bernardino Mountains both varieties have been collected; many intermediate forms difficult to assign to either category are also found there.

The vesture of *A. Douglasii* as a whole is appressed. In the San Jacinto and Palomar Mountains var. *Parishii* is represented by a form with loosely strigulose or villosulous herbage, a rather striking minor variant. Farther south, in the Cuyamaca Mountains and Lower California, the indumentum becomes appressed and sometimes quite scanty, as exemplified by the type of *Phaca pseudoocarpa* and *P. topoensis*. The former was said to possess unusually long racemes and the latter unusually narrow leaflets combined with more strongly oblique pods. However, they fall readily into my concept of var. *Parishii*.

In interior San Diego County one must exercise particular care in distinguishing the Parish milk-vetch from *A. oocarpus*, for the flowers are nearly identical in form and even the short-toothed calyx with its band of white hairs around the sinuses of the teeth is alike in both species. The stout, erect stems and stiff-walled pod persistent on the receptacle are the best differential characters of *A. oocarpus*. Near the crest dividing the cismontane slope from the desert, var. *Parishii* closely approaches and perhaps occasionally overlaps the range of *A. Palmeri*, which in ordinary circumstances is immediately recognized by its smaller pod, fewer ovules, and purple flowers. The robust phase of *A. Palmeri* with pods nearly as large and ochroleucous petals (the so-called *A. Vaseyi* var. *Johnstonii*), which is encountered around the head of Coachella Valley, occurs at elevations well below *A. Douglasii* at this latitude.

Typification of *A. Parishii* requires a word of comment, for all the material so annotated by Gray in his own herbarium is not conspecific. Parish's No. 1407 was chosen as lectotypus, because it is accompanied by a letter from the collector who refers to the plant named after him as abundant in the southern California mountains; moreover, the duplicate in the Parish herbarium was ticketed as type by Parish. The latter was collected in the San Jacinto Mountains, as were the cited paratypes (No. 402, collected in June, 1880, at Oak Grove; No. 605, collected in July of same year). A fourth specimen, from Morongo Pass, April 20, 1882 (GH) was recognized as distinct by Parish, who refers to it as *A. Crotalariae* (although not Gray's species of that name, which is our *A. pomonensis*). This last, apparently included by Gray in *A. Parishii*, actually represents the coarse form of *A. Palmeri* mentioned above.

258c. ASTRAGALUS DOUGLASII var. PERSTRICTUS

Stems erect and stiffly ascending in clumps, 4–10 dm. long, floriferous in the distal third or subterminally; *vesture* rather sparse, the thick-textured herbage greenish, the leaflets strigulose on both sides; *leaflets* (11) 13–19, narrowly elliptic, lance-oblong, or narrowly obovate, obtuse or truncate-emarginate and mucronulate, 7–25 mm. long; *peduncles* erect, 7–13 cm. long, nearly equaling the leaf; *racemes* 12–20-flowered, the axis 4–10 cm. long in fruit; *calyx* as in var *Parishii*, 4.1–5 mm. long, white-strigulose, the broadly triangular or triangular-subulate, densely ciliate teeth 0.7–1.1 mm. long; *banner* 8.5–10 mm. long, 7–8.4 mm. wide; *wings* (0.8 mm. shorter to 0.6 mm. longer than the banner) 8.6–9.1 mm. long, the claws 2.7–3.6 mm., the blades 5.8–7 mm. long, 1.8–2.5 mm. wide; *keel* (as long to 0.7 mm. shorter than the wings) 8–9.1 mm. long, the claws 3–3.8 mm., the blades 5–6 mm. long, 2.4–3 mm. wide; *pod* (3.5) 4–6 cm. long, the valves strigulose, the funicular flange about 1 mm. wide; *ovules* (48) 58–67 (average about 60).—Collections: 11 (i); representative: *Mearns & Schoenfeldt* 3247 (CAS, NY); *Munz* 9613 (POM); *Thackery* 452 (NY, WS); *Raven* 9601 (CAS, RSA).

Stony hillsides and gravelly or sandy flats in open oak woodland, 3000–4000 feet, local but forming large colonies, known only from the mountains of interior southeastern San Diego County (Campo to Jacumba and Mountain Springs), California (and doubtless immediately adjoining Baja California).—Map No. 113.—Late April to June.

ASTRAGALUS DOUGLASII var. PERSTRICTUS (Rydb.) Munz & McB. ex Munz in Bull. S. Calif. Acad. Sci. 31: 65. 1932. ("*perstricta*"), based on *Phaca perstricta* (very stiffly erect) Rydb. in N. Amer. Fl. 24: 344. 1929.—"Type collected in a hill valley between Campo and Jacumba [err. "Jocumba"], San Diego County, California, May 28, 1903, *Abrams* 3636..."

—Holotypus, NY! isotypi, DS, PH, POM, US!—*A. Parishii* subsp. *perstrictus* (Rydb.) Abrams, Ill. Fl. Pac. St. 2: 583. 1944.

The Campo milk-vetch, var. *perstrictus*, first collected in 1875 by Edward Palmer, is an astragalus of great theoretical interest. The modified flower with its poorly graduated, strongly recurved petals and the shortly toothed calyx, pubescent in a characteristic pattern, are features common to *A. Douglasii* var. *Parishii*, var. *perstrictus*, and *A. oocarpus* (all native and the last two endemic to San Diego County) and denote a close relationship and common origin. The present variety combines with extraordinary precision the tall, erect growth-habit and thick-textured foliage of *A. oocarpus* with the somewhat fewer leaflets and, more importantly, the deciduous, thinly papery and obliquely ellipsoid, pluriovulate pod of *A. Douglasii*. The combination at once suggests that var. *perstrictus* arose as an amphidiploid, although we have no evidence that the parent species actually occur together at the present time. In any case var. *perstrictus* is a self-perpetuating entity which forms colonies of monomorphic individuals. Perhaps it may be more correctly interpreted as an independent mutation representing the first step in the evolutionary process that culminated in *A. oocarpus*, of which the emmenoboid fruit must, in the context of the section, be considered a derived characteristic. A cytogenetic study may provide an insight into the origin of these interesting Californian *Inflat*.

258d. ASTRAGALUS DOUGLASII var. GLABERRIMUS

Growth-habit of var. *Douglasii*, the stems diffuse and weakly assurgent, up to 6 dm. long, sparsely strigulose or nearly glabrous, the stems and herbage green; *leaflets* (7) 13–19, lanceolate, lance- or linear-elliptic, acute (or if subobtusely mucronulate), 7–28 mm. long; *calyx* 4.8–7.4 (8) mm. long, the tube 3.1–4.2 mm. long, 2.5–3.4 mm. in diameter, the subulate teeth 1.5–3.4 (4) mm. long, the whole thinly and uniformly strigulose; *banner* 9–11 mm. long; *wings* (0.9–1.5 mm. shorter than the banner) 8–9.7 mm. long, the claws 2.5–3.5 mm., the blades 5.5–6.5 mm. long; *keel* (0.5–0.8 mm. shorter than the wings) 7.2–9.2 mm. long, the claws 2.3–4 mm., the blades 4.7–5.7 mm. long; *pod* exactly as in var. *Douglasii* but glabrous, (2.8) 3.2–5.5 cm. long, 1.5–2.5 cm. in diameter; *ovules* 22–36 (average about 32).—Collections: 10 (o); representative: *Wiggins* 4400 (CAS, DS, NY, POM), 5319 (CAS, DS, NY, UC); *Raven, Mathias & Turner* 12,596 (CAS).

Gravelly desert washes, mostly below 1600 feet, apparently local, known chiefly from the north end of the Viscaino Desert in lat. 29° 20'–30° N., Baja California (distr. Norte), and from two stations (near La Grulla) at 4200–6700 feet in Sierra San Pedro Mártir.—Map No. 113.—March to June.

ASTRAGALUS DOUGLASII var. GLABERRIMUS (very glabrous) Jones in Proc. Calif. Acad. Sci. II, 5: 645. 1895.—“Los Huevelos [a misreading of Las Huevitas,—cf. Madroño 11: 254], Lower California, 1889; Brandegee; also at San Fernando . . .”—Holotypus (from Las Huevitas), CAS!—*Phaca glaberrima* (Jones) Rydb. in N. Amer. Fl. 24: 345. 1929. (Non *A. glaberrimus* Sirj. & Rech. fil., 1953).

The var. *glaberrimus* creates a strong impression of individuality, but I can find no feature of the flower or fruit structure which cannot be duplicated somewhere in *A. Douglasii* sens. lat. Its most remarkable characteristic is the small number of ovules in proportion to the great size of the bladdery fruits. Although the variety closely resembles the more glabrous states of var. *Douglasii* in habit of growth, its flowers and leaflets are on the average fewer, while the latter tend to be narrower and furthermore are all or nearly all acute. It differs from var. *Parishii* in its thinly pubescent, long-toothed calyx and is evidently further removed from the other varieties of *A. Douglasii* than these are one from another. Possibly when better known it will deserve specific rank, but it will then require a new epithet.

All but two collections of var. *glaberrimus* known to me came from the Viscaino Desert in the general region of Catavina and Santa María, where Raven reports it as consorting with *Idria* and *Yucca* in stony washes. The records from 4200–6700 feet in Sierra San Pedro Mártir (*Wiggins & Demaree* 4867, NY; *Moran* 11,147, NY) are quite surprising, although the enormous bladdery fruits can no doubt be transported great distances by wind and an occasional establishment outside its normal range and environment expected.

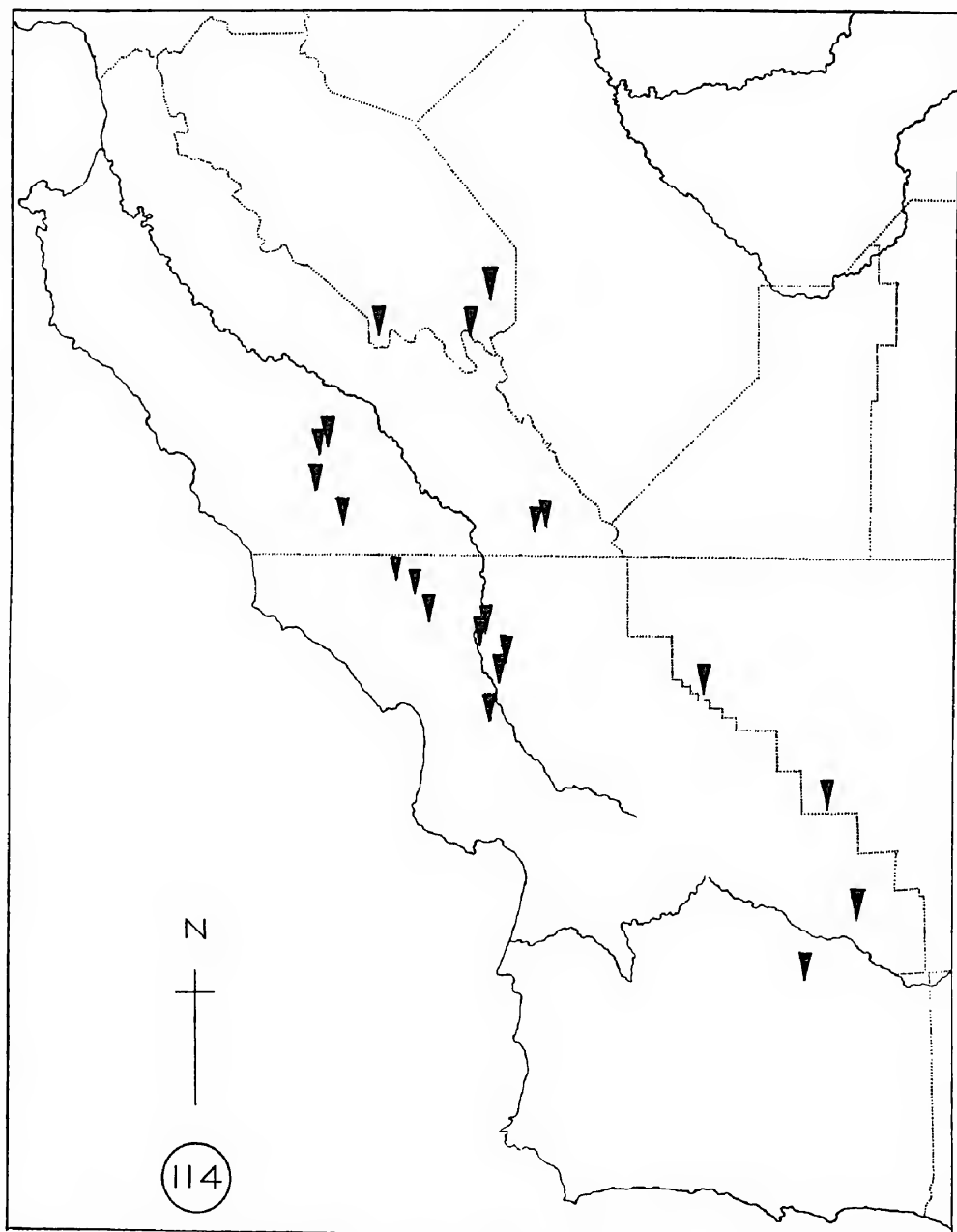
259. ASTRAGALUS MACRODON

Diffuse, perennial, of moderate stature, with a slender but at length woody taproot and superficial root-crown or shortly forking caudex, densely to rather sparsely villosulous throughout or nearly so with fine, straight and ascending or spreading, or somewhat sinuous and incurved hairs up to 0.5–0.8 (1) mm. long, the herbage greenish-cinereous or canescent, the red-margined leaflets pubescent on both sides, but sometimes thinly so above; *stems* several or numerous, 1.5–5 (8) dm. long, decumbent and ascending to form low, tufted clumps, branched or spurred at most axils preceding the first peduncle, floriferous upward from near or below the middle; *stipules* herbaceous, green or reddish, the lowest becoming firmly papery and brownish, 1.5–8 (12) mm. long, amplexicaul-decurrent around $\frac{1}{2}$ – $\frac{3}{4}$ of the stem, the lower ones triangular, the upper lance-acuminate, the blades mostly deflexed; *leaves* 5.5–15 cm. long, shortly petioled, with (11) 17–27 (29) oblong-oblongate to narrowly elliptic, or (in some lower leaves) obovate, acute and mucronulate, truncate and mucronulate, or shallowly retuse, flat or loosely folded leaflets (4) 7–22 (25) mm. long; *peduncles* divaricate or incurved-ascending, 3.5–10 (12) cm. long, shorter than the leaf; *racemes* loosely (8) 10–30 (35)-flowered, the flowers ultimately declined, the axis elongating, 3–15 (20) cm. long in fruit; *bracts* thinly herbaceous, narrowly triangular or lance-acuminate, 1.5–3.5 mm. long; *pedicels* slender, at anthesis ascending, straight, 1–3 mm. long, in fruit a trifle thickened, straight and divaricate or somewhat arched downward, 1.6–4 mm. long; *bracteoles* 2, minute; *calyx* 6.5–8.7 mm. long, densely villosulous with white or exceptionally a few black hairs, the oblique disc 1–1.5 mm. deep, the campanulate tube 3.6–4.5 mm. long, 2.7–3.5 mm. in diameter, the firm, lanceolate or subulate, reddish teeth 2.5–4.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pale or greenish-yellow, distally tinged and the banner striate with brownish-red; *banner* abruptly recurved through nearly 90°, 8.3–11.4 mm. long, the short cuneate claw abruptly expanded into a broadly ovate or suborbicular, shallowly notched or rarely entire and mucronulate blade 5.8–7.8 mm. wide; *wings* 7.8–10.4 mm. long, the claws 3.3–4.3 mm., the oblongate, obtuse-truncate or subemarginate, gently incurved blades 5.1–6.9 mm. long, 2.1–3 mm. wide, the inner margin of the left one infolded; *keel* 7.5–9.1 mm. long, the claws 3.5–4.3 mm., the broadly half-elliptic or -circular blades 4.7–5.6 mm. long, 2.2–2.8 mm. wide, incurved through 90–95° to the sharply triangular, sometimes obscurely porrect apex; *anthers* (0.5) 0.55–0.75 (0.8) mm. long; *pod* loosely spreading or declined, or (when humistrate) apparently ascending, sessile on the conical receptacle, broadly ovoid-ellipsoid, bladdery-inflated, 2–4 cm. long, 1.4–2 (or when pressed seemingly up to 2.3) cm. in diameter, rounded or broadly obconic at base, contracted distally into an erect or gently incurved, shortly deltoid, laterally compressed beak, elsewhere a trifle obcompressed, shallowly sulcate along the ventral or both sutures, the thin, pale green but commonly red-cheeked, sparsely to quite densely villosulous or strigulose-villosulous valves becoming papery, stramineous, delicately cross-reticulate, not inflexed, the funicular flange 0 or up to 1 (1.4) mm. wide; *dehiscence* apical, after falling; *ovules* 29–52; *seeds* (seldom seen) brown, punctate, dull, $\pm$ 3 mm. long.—Collections: 23 (i); representative: *Eastwood & Howell* 3851, 4089 (CAS); *Twisselmann* 1141 (CAS), 3474 (NY); *Ferris* 5796 (DS, WS); *Raven* 9189 (CAS); *Barneby* 11,250 (CAS, NY, RSA); *Keck* 2239 (DS).

Open hillsides, sometimes on the site of chaparral burns, and on bare ridges and along gullied draws in grassy hillsides, on shale or sandstone, 750–3250 feet, rare and local but forming colonies, inner South Coast Ranges in California, particularly along the foothills of the middle and upper Salinas Valley, Monterey, San

Benito, and northern San Luis Obispo Counties, southeast to the Temblor Range in western Kern County, Caliente Mountain in southeastern San Luis Obispo County, and the north slope of Sierra Madre in northern Santa Barbara County; reported by Jones, probably erroneously, from Fresno.—Map No. 114.—April to June.

ASTRAGALUS MACRODON (H. & A.) Gray in Proc. Amer. Acad. 6: 216. 1864, based on *Phaca macrodon* (with long calyx-teeth) H. & A., Bot. Beechey Voy. 333. 1838.—“California,



Map No. 114. Salinas Valley and South Coast Ranges (Monterey Bay to Santa Barbara), California. Range of *A. macrodon*.

Douglas."—Holotypus, collected in 1833, K! isotypi, BM, G, P!—*Tragacantha macrodon* (H. & A.) O. Kze., Rev. Gen. 946. 1891.

Astragalus holosericeus (silky throughout) Jones in Proc. Calif. Acad. Sci. II, 5: 638. 1895.—"Between King City and Jolon, Monterey County, California. Miss Eastwood, June 7, 1893."—Holotypus, POM! isotypus, UC! (apparently not represented at CAS).

The long-toothed milk-vetch, *A. macrodon*, is a critical species, resembling (as Jepson, 1936, p. 354, has already pointed out) *A. Douglasii* in nearly every particular except for the greater density and divergent orientation of the hairs on the leaves and pods. And I must note that the southern *A. Douglasii* var. *Parishii* is represented in the San Jacinto Mountains in Riverside County by an almost comparably villosulous minor variant. In addition to the loose pubescence *A. macrodon* has calyx-teeth averaging but by no means absolutely longer than that of *A. Douglasii*, a suffusion of brownish-red pigment along the margins of the leaflets and the petal-veins, and fewer ovules (29–52 as opposed to 51–71). These are feeble characters and the species should perhaps be reduced to varietal status, although this course would be highly inconvenient nomenclaturally because of a possible narrow priority of the epithet *macrodon*. Jepson admitted that little was known of the habits of *A. macrodon*, but I am now somewhat better informed, field experience having shed light on the ability of the species to maintain itself as a distinct entity within the range of its vigorous and common relative.

In the summer of 1954, as I drove southwest from Bitter Water in southern San Benito County toward King City, my eye was caught by a narrow, vertical stripe of pale vegetation, which stood out in sharp contrast against the dark brush of a steep north-facing hillside. On closer view the stripe resolved itself into a stand of the rare endemic mallow *Malacothamnus aboriginum*; in the interspaces between the shrubs *Astragalus macrodon* was abundant. I surmised that the strip of mallow marked the site of a former burn; the adobe topsoil had been washed out, exposing a yellowish shale, and the mallow and astragalus were precisely confined to this formation on which little else had found a foothold. I learned since from Ernest C. Twisselmann, whose knowledge of the flora of the arid inner Coast Ranges in unexcelled, that the long-toothed milk-vetch is found under similar conditions in western Kern County. Mr. Twisselmann writes (June, 1956, in correspondence): "*A. macrodon* does not occur at all here in the rolling hills of the northern Temblor Range. In the Temblor Mountains, west and north of McKittrick, the colonies are very local in weathered white or light tan shale. Usually each colony consists of relatively few individuals. It is found also in shallow, very light sandy soil around sandstone outcrops. With us it is one of the plants found only at higher elevations, at least 2500 feet in most cases, associated with Douglas oak and California juniper. At the summit of Black Canyon, a scattered colony mixed with an equally sparse colony of *A. lentiginosus* var. *idriensis* grows on a pure, rather hard shale ridge top. Only a few feet away, in better soil, *A. Douglasii* is found. *A. Douglasii*, of course, grows throughout the region in almost any kind of soil. It is common in adobe and other heavy soils in this immediate area, where *A. macrodon* is unknown . . ."

I feel safe in assuming that *A. macrodon* is adapted to an ecological niche from which *A. Douglasii* is excluded, and that the tolerances and preferences of the two species are likely controlled genetically. Perhaps the best differential character of *A. macrodon* is a physiological one.

The range of *A. macrodon* as shown on the accompanying map is a very natural one, not likely to be greatly extended. Jones (1923, p. 112) reported the species from the floor of the Great Valley at Fresno and described it as dispersed "around the San Joaquin Valley." No specimens confirming this range have been found. I suspect that flowering specimens of *A. lentiginosus* var. *nigricalycis* may have been mistaken in the past for what was long a poorly understood and rarely collected astragalus.

260. ASTRAGALUS OOCARPUS

Tall, stout, amply leafy, with a woody taproot and superficial root-crown, appearing glabrous below the inflorescence, the stems truly so, the margins and midribs of the leaflets thinly strigulose with appressed or narrowly ascending hairs up to 0.3–0.5 mm. long, the herbage deep green and of firm texture; stems stiffly erect and ascending, or finally straggling and supported on bushes, 6–13 dm. long, simple, fistular, striate below, branched or spurred at 2–6 nodes preceding the first peduncle, floriferous in the upper third or fourth; *stipules* herbaceous becoming papery, fragile, the lower ones commonly deciduous in age, 2–14 mm. long, triangular-acuminate from a broad, decurrent base, about semiamplexicaul,

deflexed; *leaves* (4.5) 6–17 cm. long, shortly petioled or the upper ones subsessile, with stout, grooved rachis and (17) 19–35 broadly lanceolate to oblong-ovate or -obovate, retuse or truncate-obtuse (and then often apiculate), flat, penninerved, dorsally carinate leaflets 6–33 mm. long; *peduncles* stout, erect or incurved-ascending, 1.5–6 (7) cm. long, much shorter than the leaf; *racemes* loosely, or in early anthesis subcompactly (15) 20–60 (75)-flowered, the flowers ascending at a wide angle, the axis (3) 4–19 cm. long in fruit; *bracts* triangular-lanceolate, 1.2–3 mm. long; *pedicels* ascending, straight, at anthesis 1–1.4 mm., in fruit greatly thickened, 2–3.5 mm. long, persistent; *bracteoles* 0–2; *calyx* 4.5–6 mm. long, thinly strigulose with white hairs but the sinuses of the teeth often densely and canescently ciliate, the subsymmetric disc 1–1.5 mm. deep, the campanulate tube 3.5–4.6 mm. long, 2.9–3.8 mm. in diameter, the deltoid or subulate teeth 0.8–1.8 mm. long, the whole becoming papery, ruptured, fragile but marcescent; *petals* ochroleucous (reportedly sometimes purple-tinged), little graduated, somewhat fleshy and commonly drying brown; *banner* abruptly recurved through 70–90°, broadly rhombic-, ovate-, or obovate-flabellate, shallowly notched, 10.5–12.5 mm. long, 7.5–9 mm. wide; *wings* 10.1–11.6 mm. long, the claws 3.6–4 mm., the oblanceolate, obliquely obovate or half-obovate, obtuse, straight or gently incurved blades 7.7–8.2 mm. long, 2.8–3.8 mm. wide; *keel* 9–10.8 mm. long, the claws 3.7–4.4 mm., the lunately half-elliptic blades 5.6–7.2 mm. long, 2.8–3.3 mm. wide, abruptly incurved through 85–95° to the sharply triangular apex; *anthers* (0.55) 0.6–0.8 mm. long; *pod* erect, persistent on the receptacle, sessile but contracted at base into a thick, broadly obconic neck, obliquely ovoid-acuminate, contracted distally into a triangular-acuminate, laterally flattened, erect or slightly incurved beak 4–7 mm. long, greatly inflated but scarcely bladdery, 1.5–2.5 cm. long, (8.5) 10–16 mm. in diameter, terete or a trifle dorsiventrally compressed, shallowly sulcate ventrally, the thinly fleshy, green, glabrous or minutely strigulose valves becoming stiffly papery, stramineous, not inflexed, the funicular flange 1–1.7 mm. wide; *dehiscence* apical, through the slightly gaping beak; *ovules* 44–58; *seeds* brown, pitted or rugulose or both, dull, 3–3.2 mm. long.—Collections: 25 (i); representative: *Palmer* 68 (NY); *Jones* 24,882 (CAS, NY, POM) and (from Julian) in 1924 (CAS, NY, POM); *Gander* 2763 2766, 2770 (SD); *Raven* 9557, 9590 (CAS, RSA).

Openings in chaparral and on gravelly flats and slopes in thin oak woodland, (1500) 2700–5000 feet, local but forming colonies, cismontane slope of the mountains of interior San Diego County, California (Palomar Mountain to Mesa Grande, Julian, and Descanso).—Map No. 113.—May to August.

ASTRAGALUS OOCARPUS (with egg-shaped pods) Gray in Proc. Amer. Acad. 6: 213. 1864, based on *A. Crotalariae* sensu Torr. in Bot. Mex. Bound. Surv. 56, Pl. 17 (err. "*crotalariaoides*"). 1859 (non Bth.).—"Mountains east of San Diego, California, June (with flowers and ripe pods); Parry."—Holotypus, ("the original of Riocreux's drawing"), collected in June, 1850, NY!—*Tragacantha oocarpa* (Gray) O. Kze., Rev. Gen. 946. 1891. *Phaca oocarpa* (Gray) Rydb. in N. Amer. Fl. 24: 343. 1929.

The egg-pod milk-vetch, *A. oocarpus*, is a coarse, ungainly astragalus, with stout, striate, hollow-cored stems, ample leaves composed of many (about 21–35) leathery, visibly nerved leaflets, and racemes of numerous, small, dingily ochroleucous flowers followed by erect, inflated, but stiff-walled fruits. It is assumed to have arisen by mutation from *A. Douglasii* var. *Parishii* of which it has retained most precisely the size, shape, and color of the petals together with a calyx similarly proportioned and bearing around the sinuses between the teeth a band of silvery hairs which contrasts with a glabrescent tube. It differs in essence from *A. Douglasii* by a thickening and coarsening of all its tissues, an effect particularly noticeable in the petals, which are of decidedly fleshy texture and turn brown in the press unless dried with more than usual care and dispatch. The pod, which is not significantly different from that of *A. Douglasii* in structure, has also assumed a texture abnormally thick for the section; at the same time the

joint between it and the receptacle has been suppressed, so that it remains firmly attached to the greatly thickened pedicels until dehiscence and afterward. This acquisition of an emmenoloboid pod seems surely to denote a reversal of the ordinary evolutionary sequence in the genus. The species differs further from var. *Parishii*, which is of fairly frequent occurrence in the higher parts of interior San Diego County, in its erect stems becoming diffuse only late in the season, if ever, when they have reached a length of three or four feet. The related *A. Douglasii* var. *perstrictus*, which is confined to a small area in the southeast corner of the county, resembles *A. oocarpus* in stature and is only distinguishable, before the papery pod has formed, by the less numerous (13–19) leaflets thinly pubescent on both sides. Usually *A. oocarpus* flowers later in the year than other astragali of the region and continues to bear flowers and fruits into the height of summer. A third milk-vetch with rather small, ochroleucous flowers must be carefully distinguished. This is *A. Deanei*, endemic to southwestern San Diego County but at elevations well below those favored by *A. oocarpus*, which it resembles in its numerous (21–29) green and almost hairless leaflets. It may be recognized by the graduated petals with banner longer and keel shorter than in *A. oocarpus*, the longer calyx-teeth, and, like *A. Douglasii*, by its deciduous pod with ripe valves of papery texture.

261. ASTRAGALUS DEANEI

Rather tall and coarse, perennial but sometimes flowering the first year, the stems glabrous, the deep green foliage nearly so, but the leaf-rachis and margins and midrib of the leaflets bearing a few scattered, subappressed hairs up to 0.35–0.5 mm. long, the inflorescence thinly pubescent; *stems* apparently several, erect or assurgent, (1.5) 3–6 cm. long, simple or nearly so, toward the base striate, hollow, greenish-stramineous or purplish; *stipules* submembranous, (2) 3.5–7.5 mm. long, decurrent around less than half the stem, the deltoid or broadly triangular-acuminate blades deflexed, glabrous dorsally, ciliate; *leaves* 8–18 cm. long, the lowest shortly petioled, the rest subsessile, with (19) 21–29 ovate-oblong to lanceolate or lance-elliptic, obtuse or truncate but commonly mucronulate, flat leaflets (0.4) 0.8–2.1 cm. long, the midrib prominent beneath; *peduncles* erect or incurved-ascending, (6) 12–20 cm. long, as long or longer than the leaf; *racemes* loosely (13) 18–25-flowered, the flowers spreading or weakly ascending, the axis early elongating, (5) 9–16 cm. long in fruit; *bracts* membranous, triangular or lanceolate, 1.5–2.5 mm. long; *pedicels* at anthesis straight, ascending, 0.9–1.2 mm. long, in fruit thickened, spreading widely or slightly recurved, 1.5–3.5 mm. long; *bracteoles* commonly 2 (0); *calyx* (4.7) 5–7.2 mm. long, thinly strigulose with mixed black and white or all white hairs, the oblique disc 1–1.6 mm. deep, the submembranous, purplish tube (2.7) 3–4.5 mm. long, (2.5) 2.9–3.8 mm. in diameter, the subulate teeth 1.8–2.7 mm. long, the whole becoming papery, ruptured, marcescent; *petals* apparently whitish, drying ochroleucous; *banner* recurved through $\pm 45^\circ$, broadly rhombic or rhombic-ovate, shallowly notched, (9.5) 12–15.2 mm. long, (6.2) 8–11 mm. wide; *wings* (8.7) 10–13.2 mm. long, the claws (3.2) 4–5 mm., the oblanceolate or narrowly obovate, obtuse, slightly incurved blades (6) 6.9–8.8 mm. long, 2.1–3.6 mm. wide; *keel* (7.8) 8.4–10.5 mm. long, the claws (3.4) 3.8–5 mm., the triangular blades (4.8) 5.1–6.2 mm. long, (2.3) 2.7–3.2 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the blunt but narrowly deltoid apex; *anthers* (0.45) 0.5–0.7 mm. long; *pod* loosely ascending, sessile, obliquely semiovoid-ellipsoid, (1.5) 2–2.8 cm. long, (0.8) 1–1.5 (1.8) cm. in diameter, bladderly-inflated, obconic at base, contracted distally into a broadly deltoid or triangular, slightly incurved, laterally compressed beak 4–6 mm. long, otherwise a trifle obcompressed, openly grooved along the nearly straight ventral suture, the dorsal suture convexly arched, the thin, pale green but purplish-tinged, thinly strigulose valves becoming stamineous, papery, not or very narrowly and obscurely inflexed, the septum when present not over 0.4 mm. wide, the funicular flange 0.7–1 mm. wide; *dehiscence* apical, through the gaping beak; *ovules* 29–40; *seeds* brown or greenish-brown, wrinkled or nearly smooth, dull,

2.1–2.5 mm. long.—Collections: 4 (o); representative: *Gander* 3487, 5292, 9009 (SD).

Open brushy slopes, in oak chaparral, sometimes on recently burned-over hillsides, $\pm$ 800–1000 feet, very local, known only from creeks tributary to the upper Otay and Sweetwater Rivers in southwestern San Diego County, California.—Map No. 113.—March to May.

ASTRAGALUS DEANEI (Rydb.) Barneby in *Aliso* 4: 133. 1958, based on *Phaca Deanei* (the collector) Rydb. in *N. Amer. Fl.* 24: 355. 1929.—“Type collected in Sweetwater Valley, San Diego County, California, May 13, 1883, G. C. Deane . . .”—Holotypus, GH!—*A. Vaseyi* var. *Deanei* (Rydb.) Jeps., *Fl. Calif.* 2: 350. 1936.

The Deane milk-vetch, at first sight a rather nondescript astragalus, is in reality well characterized. Its close relationships lie with *A. Palmeri*, native to the crest and desert slope of the mountains of southern California and northern Baja California, with widely dispersed *A. Douglasii*, and with *A. oocarpus*, the last two found also in San Diego County, but almost always at greater elevations in the interior. Jepson (1936, l.c.) interpreted it as a glabrescent, supposedly white-flowered variety of *A. Vaseyi* (= our *A. Palmeri*), but more valuable differential characters are the many leaflets, greatly thickened fruiting pedicels, and longer, better graduated petals. It is true that the detached pod is almost that of the robust northern form of *A. Palmeri* described as *A. Vaseyi* var. *Johnstonii*, but even this differs in the many (mostly 30–40) ovules or seeds. The 10–14 pairs of relatively ample, often visibly penninerved leaflets of *A. Deanei* are reminiscent of *A. oocarpus*, but the obliquely ovoid-ellipsoid, readily deciduous pod of more thinly papery texture is diagnostic in this direction. At anthesis both *A. oocarpus* and *A. Douglasii* var. *Parishii* (the form of its species geographically nearest to *A. Deanei*) can be recognized by the proportion of the shorter, more strongly recurved, and only poorly graduated petals and by the short-toothed calyx silky-ciliate about the mouth.

Little is known about the duration of the average plant of the Dean milk-vetch, but the robust growth of the majority of specimens examined suggests a strong perennial root. The typus was apparently flowering in its first season, as many *Inflati* are wont to do. It is a depauperate example of its species, with unusually small leaflets, flowers, and fruits.

LXIX (ii). Subsectio PRORIFERI

Perennial or biennial, sometimes flowering the first season; *petals* purple, or if ochroleucous then the leaflets of some leaves more than 21 or the ovules less than 30; *ovules* 7–30.—Spp. 7, of Baja California, extreme northwestern Sonora, and west edge of the Colorado Desert in southeastern California.

ASTRAGALUS sect. INFLATI subsect. PRORIFERI Jones, Rev. *Astrag.* 92, in *clave*. 1923.—Sp. typica: *A. prorifer* Jones.

Phaca subgen. *Chartocystis* sect. *Candidissimae* Rydb. in *N. Amer. Fl.* 24: 347. 1929.—Sp. typica: *P. candidissima* Bth. = *A. magdalenae* Greene.

The nucleus of the *Proriferi* as originally defined by Jones consisted of the closely related *A. Palmeri* and *A. prorifer*, each of which appeared under two names. Other species included by Jones were *A. Thurberi*, transferred below to subsect. *Aridi*; the peculiar halophyte *A. Hornii*; and *A. (Densifolii) pycnostachyus*, of which the small, compressed pod is only by coincidence similar to that of *A. prorifer*. The *Proriferi* of the following pages form a group of *Inflati* intermediate between the strongly perennial, genuine species and the short-lived *Aridi*, their flowers and ovules being, on the average, more numerous than in the first group and less so than in the second. Unusual features of individual *Proriferi* are the deciduous pedicels of *A. gruinus* and the long gynophore of *A. fastidius*; when the later has ochroleucous flowers, it mimics some members of the truly stipitate *Trichopodi*. The subsection is very highly developed in Baja California, where it ranges from sea level up to 9500 feet in Sierra San Pedro Mártir.

Rydberg's sect. *Candidissimae* of *Phaca* is listed above as a technical synonym of sect. *Proriferi*, following disposition here of its typus, *A. magdalenae*, or *Phaca candidissima* Bth. The original *Candidissimae* were an artificial group of densely pubescent astragali with inflated fruits, some of them genuine *Inflati*, others differing in connate stipules and now referred to sect. *Anemophili*.

262. ASTRAGALUS GRUINUS

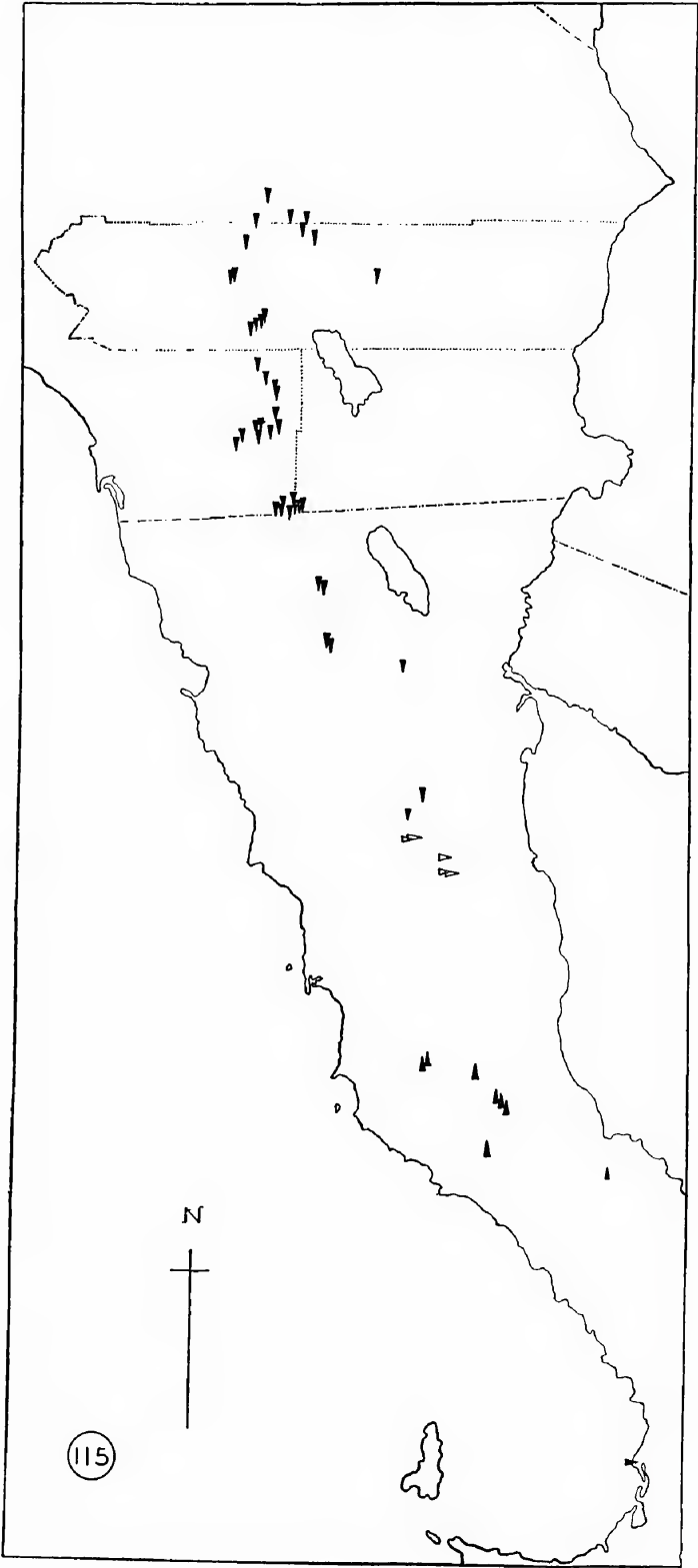
Relatively coarse, diffuse, perennial, with the growth-habit of *A. allochrous*, strigulose with appressed or in small part ascending, mostly straight hairs up to

0.4–0.6 mm. long, the stems glabrescent toward the purplish base, more densely pubescent distally, the herbage green or greenish-cinereous, the leaflets either glabrous or thinly hairy above; *stems* decumbent and incurved-ascending, 3–4 dm. long, simple, or branched or spurred at up to 6 nodes preceding the first peduncle, floriferous upward from near or below the middle; *stipules* submembranous becoming papery, 2–5 mm. long, the lowest often broader than the long, decurrent-amplexicaul around $\pm \frac{3}{4}$ to nearly the whole stem's circumference, the upper $\pm$ semiamplexicaul, with triangular or triangular-acuminate, deflexed blades; *leaves* 6–12 cm. long, the lowest shortly petioled, the rest subsessile, with (9) 17–25 narrowly to broadly oblong-elliptic or lance-oblong, obtuse, truncate-emarginate, or subacute, flat or loosely folded leaflets 5–17 long; *peduncles* rather stout, incurved-ascending, 5–9 cm. long, a little shorter than the leaf; *racemes* at first rather densely and shortly (10) 12–18-flowered, the flowers at first ascending, then spreading in age, the axis somewhat elongating, 2–5 cm. long, produced as an appendage beyond the last flower; *bracts* membranous, pallid, triangular-lanceolate, 1.5–2.5 mm. long; *pedicels* at anthesis ascending, 0.5–1.5 (2) mm. long, in fruit arched outward or divaricate, somewhat thickened but readily disjoining together with the marcescent calyx and pod; *bracteoles* usually 2, at or below the base of the calyx, rarely 0; *calyx* 5.3–6.9 mm. long, densely strigulose with black and a few white, sometimes all white hairs, the subsymmetric disc about 1 mm. deep, the tube 3–4 mm. long, 2.2–3.2 mm. in diameter, the narrowly subulate teeth 2.3–3 mm. long, the tube ruptured in age; *petals* purple, drying brownish-stramineous; *banner* abruptly recurved through $\pm 80^\circ$, broadly rhombic-ovate beyond the cuneate claw, openly notched, 8.6–11 mm. long, 5.6–7 mm. wide; *wings* as long or nearly so, 8.5–10.6 mm. long, the claws 3.3–3.8 mm., the narrowly oblong-elliptic, obtuse, lunately incurved blades 5.7–7.2 mm. long, 2–2.5 mm. wide; *keel* 7–8.6 mm. long, the claws 3.3–3.8 mm., the half-obovate blades 4–5.3 mm. long, 2–2.7 mm. wide, abruptly incurved through $\pm 90^\circ$ to the triangular, ultimately obtuse, often slightly porrect apex; *anthers* 0.5–0.65 mm. long; *pod* spreading, sessile on and firmly attached to the scarcely elevated receptacle, obliquely ovoid-ellipsoid or subglobose, bladdery-inflated, 1.8–2.8 cm. long, 1–1.5 (or when pressed seemingly up to 1.9) cm. in diameter, broadly rounded at base, contracted distally into a suberect, broadly deltoid, laterally compressed beak 2–5 mm. long, the body subterete, shallowly sulcate ventrally, the thin, pale green or purplish-tinged, strigulose valves becoming papery, stramineous, sublustrous, finely cross-reticulate, not inflexed, the funicular flange 1.2–1.5 mm. wide; *dehiscence* apical, after falling; *ovules* 24–26; *seeds* brown, pitted, dull, 2.6–2.9 mm. long.—Collections: 6 (o); representative: *Wiggins & Demaree* 4890, 5035 (DS, NY); *K. L. Chambers* 608 (DS, UC).

In pine forest, 5000–9500 feet, known only from the crest and both slopes of Sierra San Pedro Mártir, Baja California (distr. Norte).—Map No. 115.—June to October.

ASTRAGALUS GRUINUS (of the crane, or grulla), sp. nov., ab *Inflatis* affinis et similibus omnibus legumine receptaculo haud articulado cum pedicello demum deciduo, ab *A. Douglasii* var. *Parishii* petalis purpureis, ovulisque multo minus numerosis, ab *A. Palmeri* legumine majori pluriovatulo, ab *A. allochroo* (procul allopatrico) ovulis ± 12 - nec 5–10-paribus ulterius absimilis.—BAJA CALIFORNIA: Vallecitos, Sierra San Pedro Mártir, 8200 ft., 21 September, 1930, *Wiggins & Demaree* 4969. Holotypus, NY! isotypi, DS, K!

The crane milk-vetch, *A. gruinus*, is at first sight a rather commonplace astragalus to anyone familiar with the coarser and commoner *Oocarpis*, such as *A. Douglasii* or *A. allochrous*, both of which it resembles in habit. It differs from the nearly sympatric *A. Douglasii* var. *Parishii* in its purple petals, shorter calyx-teeth, and much fewer (24–26, not 42–62) ovules, and from *A. allochrous*, safely distant in Arizona and eastward, in slightly more numerous



leaflets, more compact racemes, and more numerous ovules, even though the average pod is appreciably smaller. Other related *Oocarpi* with purple flowers are *A. Palmeri*, the Baja California representatives of which have smaller, fewer-ovulate pods combined with fewer leaflets, and a range of dispersal mostly at lower elevations along the desert-bordering mountains; and *A. idrietorum* of the deserts south of San Pedro Mártir, similar to *A. Palmeri* but with even fewer ovules and pod-walls of thinner texture. The strongest differential character of *A. gruinus* is the disjointing pedicel, which falls together with the ripe fruit and marcescent calyx, a feature unique among the normally piptoloboid *Inflati* of North America. The South American *Inflati* are apparently similar in this feature to *A. gruinus*, but none of them resemble our species at all closely in fine detail.

The commoner form of *A. gruinus* from the neighborhood of Vallecitos and La Grulla has greenish foliage, a black-hairy calyx, and leaflets glabrous above, but the species is variable in density and color of the pubescence. An approximate topotypus, historically the first collection (Goldman 1224, in 1905, NY), has cinereous leaves, white-strigulose calyces, and leaflets thinly hairy above.

263. ASTRAGALUS PALMERI

Vigorous, low and diffuse, with a potentially perennial taproot, even though of rapid growth and usually short duration, sometimes flowering the first season, densely to quite thinly strigulose with fine, appressed and commonly a few narrowly ascending, straight or partly sinuous hairs up to 0.35–0.6 mm. long, the herbage varying from silvery-canescens to greenish-cinereous or rarely green, the leaflets commonly pubescent on both sides, often more densely so above than beneath, rarely glabrous or medially glabrescent above; *stems* several or numerous, prostrate or weakly ascending distally, (1) 1.5–5 dm. long (or in some seedling but already fertile plants only 1–3, erect or ascending, and 0.5–1 dm. long), simple or either branched or spurred at 1–3, more rarely at all nodes preceding the first peduncle, cinereously strigulose or glabrate, mature plants forming leafy mats or low, depressed and flattened clumps; *stipules* submembranous, the small lower ones becoming papery and fragile, (1.5) 2–6.5 mm. long, triangular or deltoid-acuminate, about semiamplexicaul-decurrent, either glabrous or pubescent dorsally, the margins ciliate and often beset with a few minute processes; *leaves* (2) 3–13 (16) cm. long, all petioled or the uppermost subsessile, with (9) 11–21 oblong, oblong-ovate or -obovate, or broadly to narrowly elliptic, acute, obtuse and mucronulate, rarely retuse-emarginate, flat or loosely folded leaflets (3) 5–25 mm. long, the midrib prominent beneath; *peduncles* ascending or incurved, 4–13 cm. long, nearly always shorter than the leaf; *racemes* loosely (or at early anthesis subcompactly) (10) 20–40-flowered, the flowers widely ascending or spreading at full anthesis, the axis early elongating, (3.5) 4–21 cm. long in fruit; *bracts* submembranous, ovate-triangular or lanceolate, 0.8–2.6 mm. long; *pedicels* ascending and a little (at times strongly) arched outward in age, at anthesis 0.5–1.8 mm., in fruit a trifle thickened, 0.8–3 (3.4) mm. long, persistent; *bracteoles* nearly always 2, commonly minute, sometimes 0; *calyx* 3.6–6.6 mm. long, strigulose with all black, all white, or mixed black and white hairs, the slightly oblique disc (0.6) 0.7–1.1 mm. deep, the campanulate or ovoid-campanulate, pallid or purplish tube (2.2) 2.7–3.8 mm. long, (1.8) 2–3.4 mm. in diameter, the subulate or triangular-subulate teeth (0.9) 1–2.8 mm. long, the ventral pair either longer or shorter but commonly broader than the rest, the whole becoming papery, ruptured, marcescent; *petals* mostly bright pink-purple with striate eye in the banner, more rarely ochroleucous tipped or veined with dull, lurid purple; *banner* abruptly recurved through nearly 90°, ovate- or obovate-cuneate, shallowly notched, 7–10.3 mm. long, 5.2–8 mm. wide; *wings* 6.7–9.2 mm. long, the claws

2.5–3.7 mm., the obliquely oblong-elliptic, -oblanceolate, or -obovate, obtuse, gently incurved blades 4.4–6.2 mm. long, 1.7–3 mm. wide; *keel* 6.2–8.8 mm. long, the claws 2.5–3.7 mm., the lunately half-elliptic blades 4.1–5.5 mm. long, (2) 2.2–2.6 mm. wide, abruptly incurved through 90–95° to the triangular, obtuse or subacute, often slightly porrect and sometimes beaklike apex; *anthers* (0.4) 0.45–0.7 mm. long; *pod* ascending, spreading, or (when large) declined, sessile on the flat or conical receptacle, obliquely ovoid-ellipsoid or ovoid-acuminate, moderately to strongly inflated, 0.9–2.3 cm. long, (4) 5–15 (17) mm. in diameter, rounded or broadly to narrowly cuneate at base, contracted distally into a compressed, triangular or deltoid-acuminate, erect or slightly incurved beak $\frac{1}{3}$ – $\frac{1}{5}$ th as long as the body (and 2–7 mm. long), the body either a little dorsiventrally or laterally compressed, the filiform sutures either depressed or prominent, the ventral one varying from nearly straight to a trifle less convex than the dorsal one, the lateral faces distended and plumply rounded, the thin, pale green or purple-speckled or -suffused, thinly to densely strigulose valves becoming stramineous, papery (but hardly diaphanous), not inflexed, the funicular flange narrow or obsolete (0–0.6 mm. wide); *dehiscence* both apical and basal, after falling; *ovules* (7) 12–31; *seeds* orange- or mahogany-brown, $\pm$ rugulose or punctate, dull, 2–3 mm. long.—Collections: 51 (iii); representative: *S. B. & W. F. Parish* 735 (DS, ND, NY); *Moran* 837 (CAS); *L. S. Rose* 35,700 (CAS, WS); *Munz* 15,128 (CAS, POM); *Epling & Robison* (from Box Canyon) in 1932 (CAS, NY); *Ripley & Barneby* 10,083 (CAS, RSA); *Pringle* (from Baja California) in 1882 (ND, NY); *Gander* 2630 (SD).

Open gravelly or sandy flats, hillsides, canyon benches and boulder-strewn slopes or washes, commonly with piñon, Joshua-tree, scrub-oaks or manzanitas, but sometimes brought down and vigorously flourishing on the desert floor, mostly on granitic bedrock, (500) 1000–4000 (5450) feet, rather common and locally abundant around the west and northwest edge of the Colorado Desert, from the head of Coachella Valley (foothills of the San Bernardino, Little San Bernardino and Eagle Mountains) south into northern Baja California in lat. 30° N.—Map No. 116.—December to June.

ASTRAGALUS PALMERI (Edward Palmer, 1831–1911, widely traveled plant collector and ethnologist) Gray in Proc. Amer. Acad. 7: 398. 1868.—“Camp Grant, in southern Arizona, Dr. Edward Palmer, comm. Engelmann.”—Holotypus, dated April 22, 1867, GH! isotypus, MO!—*Tragacantha Palmeri* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca Palmeri* (Gray) Rydb. in N. Amer. Fl. 24: 355. 1929.

Astragalus Vaseyi (George Richard, son of agrostologist George Vasey) Wats. in Proc. Amer. Acad. 17: 370. 1882.—“At Mountain Springs, San Diego County, California, by G. R. Vasey, 1880 . . .”—Holotypus, *Vasey* 139, collected in June, 1880, GH! isotypi, NY, P, US!—*Phaca Vaseyi* (Wats.) Rydb. in N. Amer. Fl. 24: 354. 1929.

Astragalus metanus (of the border) Jones in Proc. Calif. Acad. Sci. II, 5: 666. 1895.—“Hanson’s Ranch, Lower California, near the border, Brandegee, April 18, 1885 . . . The type is in the California Academy of Sciences.”—No corresponding spm. found at CAS, and T. S. Brandegee is not known to have been in Baja California in 1885. Typus probably collected by C. R. Orcutt, who collected spms. at Hansen’s Ranch on April 18, 1885; presumed isotypi, ND (No. 138), NY, US (No. 510), WS!—*Phaca metana* (Jones) Rydb. in N. Amer. Fl. 24: 354. 1929. *Astragalus Vaseyi* var. *metanus* (Jones) Munz & McB. in Bull. S. Calif. Acad. 31: 66. 1932.

Astragalus Vaseyi var. *Johnstonii* (Ivan Murray Johnston, 1898–1960, world authority on *Boraginaceae*, student of American desert floras) Munz & McB. ex Munz in Bull. S. Calif. Acad. 31: 66. 1932.—Type from Keyes Ranch, Little San Bernardino Mts., *Munz & Johnston* 5271 . . .—Holotypus, collected May 7, 1922, POM! isotypi, DS, NY (fragm.)! *A. Palmeri* var. *Johnstonii* (Munz & McB.) Barneby ap. Shreve & Wiggins, Veg. Fl. Son. Des. 702. 1964.

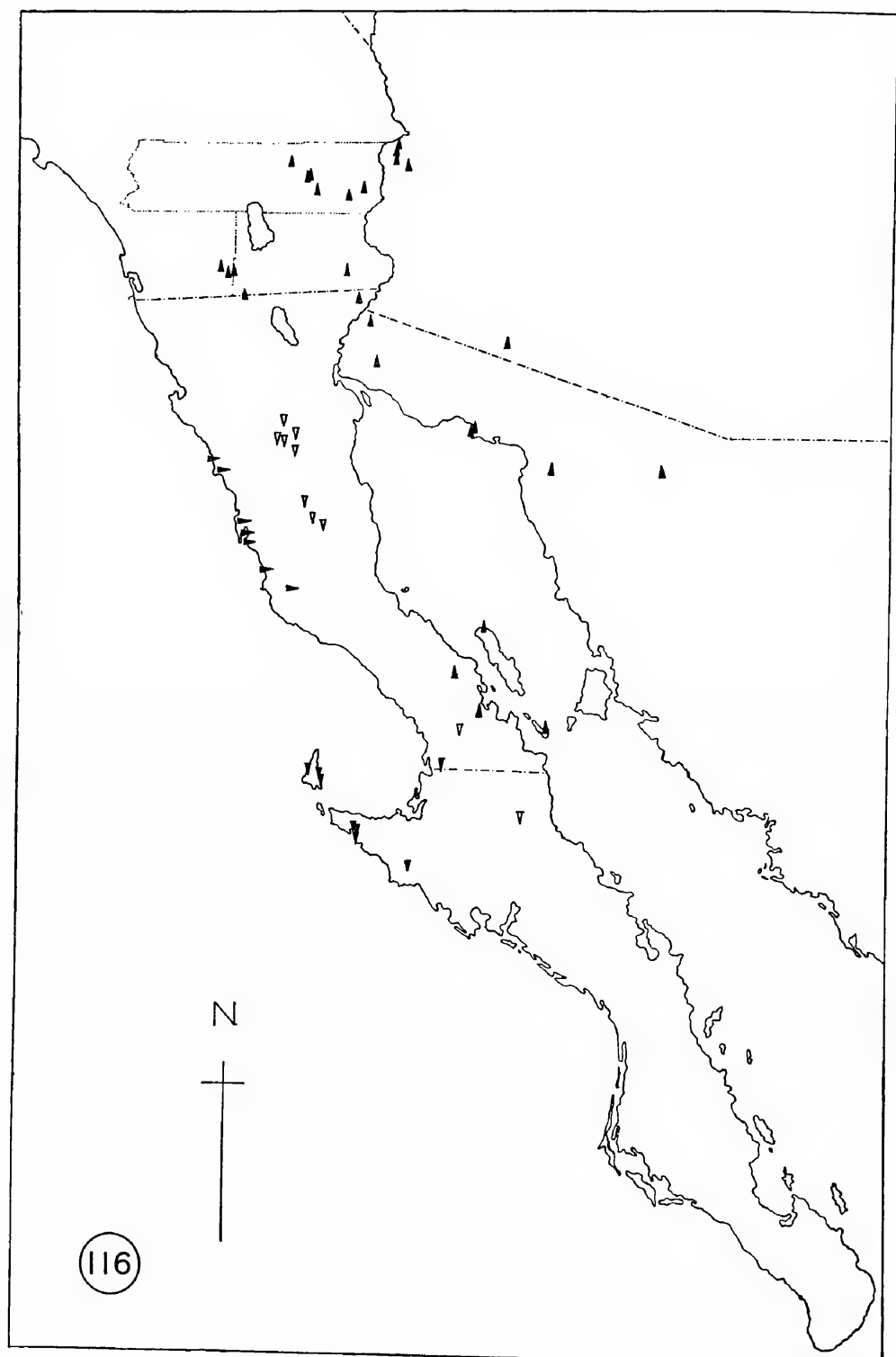
The Palmer milk-vetch is closely related to *A. Douglasii*, from which it differs in its smaller (ordinarily very much smaller) fruit, fewer ovules, and (with rare exception mentioned below) in its purple petals. The species is polymorphic, varying from one population to

the next in size of the pod, length of the calyx-teeth, color of the calyx-hairs and of the petals, and in density and distribution of the pubescence. The variations are to a large degree correlated with a north-south trend in dispersal, for the smallest pods, most silvery herbage, and shortest calyx-teeth are constantly associated only southward; the opposite conditions, complicated by the occurrence of ochroleucous flowers, are encountered all together only about the north end of Coachella Valley. However, the variation is continuous and even though a given extreme may be confined to a small area and dominant within it, no single combination of characters excludes all others from its range. Thus in Morongo Valley and the Little San Bernardino Mountains, where *A. Palmeri* is represented most commonly by a robust, glabrescent phase with large pods described as *A. Vaseyi* var. *Johnstonii*, the leaflets vary, sometimes even within a small colony of plants otherwise alike, from glabrous to densely strigulose on the upper side; in the same area the 21–31-ovulate pod varies from 1.6 to 2.3 cm. in length, the calyx-teeth from 1.4 to 2.8 mm., and the petals from ochroleucous faintly veined with brownish-purple to bright magenta-purple. Between Palm Springs and Vallecito, in the foothills and up to 4000 feet in the Santa Rosa Mountains, the leaflets of the Palmer milk-vetch vary from thinly to canescently strigulose above, the 14–22-ovulate pod is 1.1–1.9 cm. long, the calyx-teeth mostly 1.4–2 mm. long, and the petals are consistently purple. Following the species southward from the Borrego Desert into northern Baja California, we find the pod on the average smaller, mostly 0.9–1.4 (rarely to 1.8) cm. long, and 12–17-ovulate; while the calyx-teeth are 0.9–1.7 mm. long, the herbage nearly always gray or silvery, and the petals once again always purple. The vesture of the calyx varies from black to white through the range of the whole species, and as usual the preponderance of hairs of one color has no taxonomic significance. The black-calyxed var. *metanus* is only one of many minor variants; in fact, Orcutt himself collected white-hairy plants in the type-station.

The identity of *A. Palmeri* with what has been known to California botanists as *A. Vaseyi* was first noted by Tidestrom (Fl. Ariz. & New Mex. 210. 1941). The distance between the supposed type-station in southeastern Arizona and the main range of the species in California is remarkable but not without precedent, for bicentric dispersals of a similar type are well known (cf. Kearney & Peebles, 1942, p. 8). Palmer was at Camp Grant (cf. McVaugh's Life) at the day specified on the duplicate labels at MO and GH, and there seems no good reason to doubt the authenticity of the data. It is odd, nevertheless, that no further collections of *A. Palmeri* have since been made in Arizona, despite deliberate search around Camp Grant. A specimen cited by Kearney & Peebles (*Mohr* from the San Carlos River, US) is a mixture of genuine *A. Palmeri* (possibly a fragment of the typus) and *A. arizonicus*, a species common in southeastern Arizona. Palmer was in San Diego County, California, in the summer of 1861 while working for the State Geological Survey, and there is a bare possibility that the astragalus was actually collected in California during that season. Pending confirmation of its existence in Arizona, the type-station has been omitted from Map 115.

264. ASTRAGALUS PRORIFER

Caulescent annual or perhaps sometimes perennial of short duration flowering the first season, variable in stature, villosulous throughout or nearly so with spreading, widely ascending, or more narrowly incurved-ascending hairs up to 0.5–0.75 (0.9) mm. long, the stems and herbage canescent at first or permanently, the leaves sometimes greenish-cinereous in age, the leaflets pubescent on both sides or medially glabrescent above; *stems* incurved-ascending from the root-crown at soil-level, (0.7) 1–5.5 dm. long, in precociously flowering plants few and slender, simple, in more robust plants stout, numerous, and spurred or branched at several nodes preceding the first peduncle, floriferous from near or above the middle; *stipules* 2–6 mm. long, the lowest ones early becoming papery, strongly amplexicaul-decurrent but free, the upper ones firmer, ovate, broadly deltoid, or triangular-acuminate, thinly villousulous dorsally; *leaves* 3–11 cm. long, the lower ones shortly petioled, the upper sessile, with 13–21 oblong, lance-oblong or -elliptic, or broadly lanceolate, obtuse, obtuse and mucronulate, or in some lower leaves emarginate and in some upper ones subacute, flat or loosely folded leaflets (3) 5–21 mm. long; *peduncles* stout or quite slender, 2.5–9 cm. long, mostly a little shorter than the leaf; *racemes* rather densely to quite openly 10–35-flowered, the flowers ascending at a wide angle or horizontal in age, the axis a little elongating, 4–10 cm. long in fruit; *bracts* submembranous, ovate or lance-acuminate, 1–2.5



Map No. 116. Baja California and parts of adjoining states. Range of *A. insularis*: var. *insularis*; var. *quentinus*; and var. *Harwoodii*; and of *A. prorifer*.

mm. long; *pedicels* at anthesis 0.2–1 mm. long, in fruit somewhat thickened, arched outward, 0.5–1.4 mm. long, persistent; *bracteoles* 0–2; *calyx* 4–5.2 mm. long, densely villosulous like the herbage with white or partly black hairs, the subsymmetric disc 0.6–1 mm. deep, the campanulate tube 2.4–3.3 mm. long, 2–3 mm. in diameter, the subulate to broadly triangular-subulate teeth 1.5–2.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pink-purple, the color apparently variable in depth; *banner* recurved through $\pm 45^\circ$ (further in withering), ovate- or flabellate-cuneate, openly notched, 7.6–9 mm. long, 4.4–7.6 mm. wide; *wings* 6.6–8 mm. long, the claws 2.5–2.8 mm., the oblanceolate or narrowly obovate, obtuse or (when broad) obscurely erose-emarginate blades 4.5–5.7 mm. long, 1.8–2.6 mm. wide, one more strongly incurved than the other; *keel* 6–7.6 mm. long, the claws 2.7–3.4 mm., the lunately elliptic blades 3.5–4.8 mm. long, 2–2.3 mm. wide, incurved through $90\text{--}100^\circ$ to the triangular but ultimately obtuse, sometimes slightly porrect apex; *anthers* 0.45–0.6 mm. long; *pod* loosely ascending, widely spreading, or declined, sessile on and disjointing from an incipient gynophore 0.4–0.7 mm. long, obliquely ovoid-ellipsoid or ellipsoid, 1–2.3 cm. long, 4–10 mm. in diameter, little or moderately inflated but relatively firm-walled and when small scarcely bladdery, rounded or broadly obconic at base, contracted distally into an erect or slightly declined, triangular, shortly cuspidate, laterally compressed beak $\pm 2\text{--}4$ mm. long, carinate ventrally by the prominent but filiform, gently convex or nearly straight suture, the dorsal suture more strongly or even gibbously convex, the thin, inwardly glabrous valves becoming papery, stramineous, finely reticulate, thinly to densely and canescently strigulose-villosulous with sinuously ascending, spreading, or subappressed hairs, not inflexed, the funicular flange obsolete or nearly so, not over 0.2 mm. wide; *dehiscence* apical, after falling; *ovules* 7–16; *seeds* orange-, purplish-, or chestnut-brown, smooth, dull or somewhat lustrous, 1.9–2.8 mm. long.—Collections: 10 (o); representative: *Wiggins* 9796, 9911 (DS); *Brandegee* (from San Luis) in 1889 (UC); *Chambers* 604, 604a (DS); *Moran* 11,076 (DS, NY).

Sandy flats, washes, and open slopes in pine-oak forest and xeric shrubbery, reported definitely from between 3500 and 6000 feet near its northern limit, perhaps lower and in desert environment southward, apparently local, known only from Sierra San Pedro Mártir, Baja California, and south interruptedly to the northern extremity of the Southern District, lat. $27^\circ 30'\text{--}31^\circ 10'$ N.—Map No. 116.—April to June.

ASTRAGALUS PRORIFER (prowed, of the fruit's prominent beak) Jones in Zöe 4: 275. 1893 ("proriferus").—"San Pedro Mártir, Lower California, May 5, 1893, Brandegee."—Cotypi, both labeled "type" in Jones's hand, collected May 4 and May 16, 1893, the first from Santa Cruz Creek, UC! isotypus, labeled "April 16, 1893," NY!—*Phaca prorifera* (Jones) Rydb. in N. Amer. Fl. 24: 355. 1929.

Astragalus julianus (of San Julio) Jones in Proc. Calif. Acad. Sci. II, 5: 667. 1895.—"San Julio, Lower California, Brandegee, April 19, 1889."—Holotypus, UC! isotypi (fragments), NY, POM!

The prowed milk-vetch, *A. prorifer*, is closely related to *A. Palmeri*, perhaps not specifically distinct. The two species are almost identical in the form of the flowers and fruits and are subject to the same type and degree of variation in stature and duration of the plant, in density of vesture, and in size of the ripe pod. The extreme forms of *A. prorifer* are easily distinguished in practice by the villosulous or sometimes tomentulose pubescence of the leaves and stems; and when pods of the same size-range are compared, those of *A. prorifer* have fewer ovules or seeds. The material here referred to the prowed milk-vetch includes three superficially disparate types which deserve further analysis. The nomenclaturally typical phase of *A. prorifer* is a comparatively robust, canescently villous plant with dense racemes of 15–30 flowers borne on pedicels which are very short at anthesis. It was described by Jones as "shrubby at the base," but although probably perennial the root and caudex, if any, have not actually been collected. The typical pod is small ($\pm 12\text{--}14$ mm. long) and canescently villo-

sulous with curly hairs. Brandegee's plants, collected on the west slope of San Pedro Mártir in the neighborhood of Valladares and La Grulla, are closely matched by plants from Rancho La Suerte (*Moran 11,076*) and La Encinal (*Wiggins 9796*). The typus of *A. julianus* consists of several much more slender plants flowering in their first year. The racemes are looser and the flowers themselves fewer and slightly smaller, borne on pedicels at anthesis a trifle longer and developing into pods of the same size but less densely pubescent; their vesture of curled ascending hairs does not conceal the surface of the valves as in typical *A. prorifer*. The type-locality of *A. julianus* lies almost 250 miles southeastward along the Peninsula from San Pedro Mártir, and it is easy to understand how Jones came to describe two species in the group. However, there is now a close match for *A. julianus* in plants collected at the south end of Sierra San Pedro Mártir at Los Emes (*Wiggins 9711*), and a collection in flower from an intermediate station at San Luis (lat. 28° 25' N.) is similar except for the more thinly hirsutulous, mostly greenish herbage. What I take to be a third variant of *A. prorifer* is known from the precipitous west slope of San Pedro Mártir in Cañon del Diablo (*Chambers 604, 604a*). Here the vesture of leaves and stems is ascending rather than spreading and the pod is larger than in the foregoing variants, up to 22 mm. long and up to 14–16-ovulate. These plants resemble *A. Palmeri* in almost all characters except the loose vesture and might be interpreted as forming a connecting link with that species, which reaches its known southern limit of dispersal at the north end of San Pedro Mártir.

According to Jones *A. prorifer* should differ from *A. julianus* in having the fruits borne in spikes rather than racemes, in its woolly rather than silky pubescence, and in dark purple rather than whitish flowers. The pedicels of typical *A. prorifer* are short at anthesis but become evident at the fruiting stage, so that the inflorescence is never a true spike and not fundamentally different from the looser, fewer-flowered one of *A. julianus*. The flowers of *A. julianus* were originally described as white tipped with purple, and in similar modern collections are clearly purplish. The difference in pubescence is one of density and not due to any fundamental difference in the quality of the hairs. Now that the geographical separation has broken down so completely, I feel confident that *A. prorifer* and *A. julianus* represent no more than two variants of one variable species.

Little difficulty should be encountered in recognizing *A. prorifer*, the only member of its section in Baja California characterized by villosulous leaves. On both slopes of San Pedro Mártir the species is sympatric with *A. gruinus*, but this is distinguished by its somewhat larger flowers, more numerous (24–26, not 7–16) ovules, and eventually by its larger, proportionately plumper, greatly swollen fruits which remain attached to the receptacle when ripe and fall to the ground together with the disjoining pedicels.

265. ASTRAGALUS IDRIETORUM

Perennial but of rapid growth and short duration, with a taproot and ultimately knotty root-crown, the diffuse stems sometimes becoming indurated and suffruticulose at base, strigulose nearly throughout with fine, straight, appressed or subappressed hairs up to 0.45–0.75 mm. long, the herbage green or greenish-cinereous, the leaflets pubescent on both sides but commonly more thinly so or nearly glabrous above; *stems* several, decumbent and incurved-ascending, 2–4 dm. long, simple or (when vigorous) spurred or branched at 1–3 nodes preceding the first peduncle, floriferous upward from near or below the middle; *stipules* thinly herbaceous becoming papery-scarious, triangular or triangular-acuminate, 2–4.5 mm. long, $\pm$ semiamplexicaul-decurrent; *leaves* (3.5) 4.5–11 cm. long, the lowest petioled, the uppermost subsessile, with (9) 11–19 lanceolate, linear-lanceolate, or -elliptic, acute or subobtusate and mucronulate, flat or loosely folded leaflets (4) 5–16 (23) mm. long; *peduncles* incurved-ascending, (3) 4–10 cm. long, about equaling the leaf; *racemes* loosely (8) 10–20-flowered, the flowers ascending, the axis elongating, (2) 3.5–7 cm. long in fruit; *bracts* submembranous, ovate or broadly triangular, 0.8–1.5 (2) mm. long; *pedicels* ascending, straight, at anthesis 0.4–0.9 mm., in fruit a little thickened, 0.6–1.6 (2) mm. long; *bracteoles* 0 (rarely a minute scale); *calyx* 4–5.2 mm. long, thinly strigulose with white and sometimes a few black hairs, the subsymmetric disc 0.5–1 mm. deep, the campanulate, pale green or purple-tinged tube 2.4–3.2 mm. long, 2–2.9 mm. in diameter, the subulate or triangular-subulate teeth 1.3–2.2 mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* pink-purple,

drying violet; *banner* gently recurved through 45° , ovate-cuneate, deeply notched, (6.5) 8–9 mm. long, 5–7.7 mm. wide; *wings* (5.7) 7–7.9 mm. long, the claws (2.2) 2.5–2.9 mm., the obliquely elliptic or obovate, obtuse, gently incurved blades (3.8) 4.2–4.7 mm. long, (1.8) 2.2–3.1 mm. wide; *keel* (5.7) 6.6–7.4 mm. long, the claws (2.2) 2.5–3 mm., the lunately half-elliptic or half-obovate blades (3.8) 4.2–4.7 mm. long, 2–2.7 mm. wide, incurved through $85\text{--}95^\circ$ to the rather sharply triangular, obscurely porrect apex; *anthers* 0.45–0.55 mm. long; *pod* ascending, sessile, readily deciduous from the slightly elevated receptacle, very obliquely ovoid or half-ovoid, bladdery-inflated, 1.2–2.2 cm. long, 6.5–13 mm. in diameter, rounded or broadly turbinate at base, contracted distally into an erect or slightly incurved, triangular-cuspidate, laterally compressed beak about 3–5 mm. long, the body a trifle depressed or shallowly sulcate ventrally, the sutures both filiform, the ventral one nearly straight or at least much less strongly convex than the dorsal one, the thin, pale green or purplish, sparsely strigulose valves becoming stramineous, lustrous, papery-membranous, subdiaphanous, not inflexed, the funicular flange subobsolete or up to 0.5 mm. wide; *dehiscence* apical, after falling, through the slightly gaping beak; *ovules* 8–12; *seeds* brown, smooth but dull, 1.5–2.9 mm. long.—Collections: 9 (o); representative: *Wiggins 5341* (CAS, DS, UC); *Mrs. Harvey* (from Catavíná) in 1954 (SD, RSA); *Raven, Mathias & Turner 12,550, 12,564* (CAS); *Moran 10,335* (NY, SD).

Gravelly or sandy flats and desert washes up to 2150 feet, apparently not uncommon locally in the Viscaino Desert, where associated with *Idria columnaris*, between lat. 29° and 30° N.—Map No. 115.—February to April.

ASTRAGALUS IDRIETORUM (of *Idria* groves) Barneby ap. Shreve & Wiggins, Veg. Fl. Son. Des. 703. 1964.—“Estado BAJA CALIFORNIA (Norte): 10 miles s. of El Mármol, March 6, 1930, *Ira L. Wiggins 4377* . . .”—Holotypus, CAS! isotypi, DS, GH, NY, POM!

Baja California is particularly rich in members of sect. *Inflati*, possessing no less than six species with small, loosely racemose, purple flowers and papery or papery-membranous pods. Among these *A. magdalenae* is easily recognized by its dense, satiny or silvery-silky vesture; *A. prorifer* by its villousulous leaves; *A. insularis* and its varieties by their few (3–9) flowers and obligately annual root; and *A. gruinus* by its pluriovulate emmenoloboid pod deciduous with the pedicel and its habitat at 5000 feet upward on Sierra San Pedro Mártir. At middle and low elevations, that is below 5000 feet, from the boundary southward one encounters in turn *A. Palmeri* which extends south to lat. 31° N., *A. idrietorum* approximately between 30° and 29° N., and finally isolated at the middle of the Peninsula the poorly known *A. piscinus*. The last named is comparatively well marked on account of its deciduous pedicels, sparse vesture, relatively long pod (2–3 cm.) and 19–25 ovules, all at variance with *A. idrietorum*. It remains only to separate the present species from *A. Palmeri*, a matter of some difficulty. Comparison of the descriptions serves to emphasize the similarity of the two species in nearly all characters, although they differ in texture of the pod, in ovule-number, and in curvature of the banner. However *A. Palmeri* is quite variable, and if I may limit the field of comparison with *A. idrietorum* to those populations found in Baja and extreme southern Alta California (where intergradation would be expected), further contrasts come to light. Near its southern limit of dispersal *A. Palmeri* is nearly always abundantly pubescent, with gray or silvery foliage and leaflets commonly more densely hairy above than beneath, while the racemes are often well over 20-flowered. The pod is proportionately narrower than in *A. idrietorum*, less inflated, and sometimes hardly more than turgid, varying from 4 to 9 mm. and not 6.5 to 13 mm. in diameter against a length of about 1 to 2 cm. Only the smallest pods of *A. Palmeri* (and they become, in general, smaller southward) are less than 14-ovulate, and these are of chartaceous texture, thick enough at maturity to conceal the seeds. In *A. idrietorum* the ovules are never above 12, even in the largest and most swollen fruits, and the texture of the ripe valves is so thin as to reveal the seeds within their transparent envelope. Finally *A. Palmeri* belongs or is at least commonest and most fruitful in the zones of nut pine, scrub-oak and *Arctostaphylos* upward from 2000 feet, descending only sporadically to the desert floor east of the mountains. Its known range lies around the southeast edge of the California floristic province, and it is essentially (except possibly for its dubious type-locality in Arizona), like the closely related *A. Douglasii*, a Californian type. By contrast *A. idrietorum* is a true desert plant, forming part of an arid tropical flora with floristic relationships southward. In the context of the section,

A. idrietorum unquestionably deserves the rank of species. I should mention that during preliminary studies the material at CAS and SD was annotated as an unnamed variety of *A. Vaseyi*.

266. ASTRAGALUS PISCINUS

Perennial (? the root unknown), thinly strigulose with straight, appressed or subappressed hairs up to 0.7–0.8 mm. long, the herbage green, the leaflets glabrous above; *stems* $\pm$ 3 dm. long, spurred or branched at 1 or more nodes preceding the first peduncle, rather coarse, hollow below, striate, stramineous; *stipules* submembranous becoming papery, 3–5 mm. long, ovate-acuminate or lanceolate, semiamplexicaul-decurrent; *leaves* 6–13 cm. long, shortly petioled or subsessile, with 17–25 rather distant, linear-oblongate or -elliptic, obtuse and mucronulate, or subobtuse, flat or marginally involute leaflets (3) 7–30 mm. long; *peduncles* stout, striate, 12–15 cm. long; *racemes* loose, $\pm$ 20-flowered, the attitude of the readily deciduous flowers and pods unknown; *bracts* lanceolate, becoming papery-scarious, 2–3 mm. long; *pedicels* at anthesis $\pm$ 0.5 mm., in fruit thickened, 0.5–1.7 mm. long, arched outward, readily disjoining; *bracteoles* 0; *calyx* $\pm$ 5 mm. long, loosely black- and white-strigulose, the subsymmetric disc 0.9 mm. deep, the campanulate tube 3.5 mm. long, 2.4–3 mm. in diameter, the subulate teeth 1.5–1.6 mm. long; *petals* purple; *banner* gently recurved through $\pm$ 45°, rhombic-ovate-cuneate, notched, 10–12.8 mm. long, 6–6.5 mm. wide; *wings* 9.3–11.5 mm. long, the claws 4–4.9 mm., the narrowly oblong-oblongate, erose-emarginate, slightly incurved blades 5.6–7.5 mm. long, 2–2.2 mm. wide; *keel* 8.4–9.1 mm. long, the claws 4.2–4.8 mm., the lunately half-elliptic blades 4.6–5.1 mm. long, 2.4–2.6 mm. wide, incurved through $\pm$ 100° to the obtusely triangular, subporrect apex; *anthers* 0.5 mm. long; *pod* (probably spreading or declined) sessile on and readily disjoining from an obscure gynophore, the body obliquely elliptic in profile, bladdery-inflated, 2–3 cm. long, 1–1.2 cm. in diameter, broadly obconic at base, contracted distally into an erect or slightly incurved, laterally flattened, triangular or triangular-acuminate beak $\pm$ 5.5–7 mm. long, shallowly sulcate along the nearly straight ventral suture, the dorsal suture gently convex, the papery-membranous, thinly strigulose valves becoming stramineous, diaphanous, not inflexed, the funicular flange very narrow, $\pm$ 0.3–0.5 mm. wide; *ovules* 18–25; *seeds* brown, dull, smooth, 1.5–1.9 mm. long.—Collections: 1 (typus only).

Habitat not recorded, but to be sought on dunes or sandy flats on the Pacific shore of Baja California, known only from the type-locality at Lagoon Head.—Map No. 115.—February to April, the season probably dependent on accidents of rainfall.

ASTRAGALUS PISCINUS (Jones) Barneby ap. Shreve & Wiggins, Veg. Fl. Son. Des. 703. 1964, based on *A. Douglasii* var. *piscinus* (of a lagoon or tank) Jones, Contrib. West. Bot. 10: 61. 1902, based in turn on *A. piscinus* Jones in Proc. Calif. Acad. Sci. II, 5: 645. 1895, nom. provis.—“Palmer’s specimen from Lagoon Head, Lower California, March 6–15, 1889.”—Holotypus, US! isotypi, GH, K, NY (2 sheets), some numbered Palmer 776.—*Phaca piscina* (Jones) Rydb. in N. Amer. Fl. 24: 345. 1929. *Astragalus Crotalariae* var. *piscinus* (Jones) Jeps., Fl. Calif. 2: 350. 1936, quoad nom. sol.

The lagoon milk-vetch, *A. piscinus*, is inadequately known but seems to have strong technical characters in the context of its section. It resembles *A. allochrous* rather closely, differing in its narrower, less densely pubescent leaflets, slightly but significantly longer petals (banner $\pm$ 10–13, not 7.2–9.4 mm., keel 8.4–1, not 6.2–7.5 mm. long), and especially in the readily disjoining pedicels. The range of *A. allochrous* is not known to extend south or west of Arizona, and it is probably of greater use to distinguish *A. piscinus* from its peninsular kindred, such as *A. idrietorum* and *A. fastidius*, found immediately to the north and south of Lagoon Head. Both of these have pedicels persistent in fruit, while the pod of *A. fastidius* is raised on a long, stipelike gynophore and that of *A. idrietorum* is only 8–12 (not 18–25)-ovulate. Other features

distinguishing *A. piscinus* from *A. idrietorum* are the longer racemes of larger flowers and the decidedly longer pod of thicker texture.

Jepson's combination *A. Crotalariae* var. *piscinus* was applied by its author to the very different *A. magdalenae* var. *Peirsonii*, and is only a technical synonym of *A. piscinus*.

267. ASTRAGALUS FASTIDIUS

Tall, relatively slender perennial with a woody taproot and at length basally indurated stems, strigulose-villosulous with fine, shorter and subappressed, often more or less sinuous, together with longer ascending or incumbent hairs up to 0.35–0.6 mm. long, the stems very densely so, canescent, the herbage greenish-cinereous, the leaflets bicolored, brighter green and glabrous or more thinly pubescent above; *stems* several or numerous, erect and ascending in bushy clumps, 1.5–5 dm. long, commonly branched at base and spurred at 1–several nodes preceding the first peduncle, floriferous upward from near or above the middle; *stipules* herbaceous, the lowest ones becoming papery and pallid, broadly deltoid or lance-acuminate, (2) 3–9 mm. long, about semiamplexicaul-decurrent, the blades recurved; *leaves* (2) 5–15 cm. long, the lowest slender-petioled, the upper ones sessile, with 17–31 (35) oblong-elliptic, -obovate, or oval, truncate or emarginate, flat or loosely folded leaflets (3) 5–20 mm. long; *peduncles* slender, erect or incurved-ascending, (3) 5–14 cm. long, a little longer or shorter than the leaf; *racemes* loosely 7–17-flowered, the flowers ascending or in age spreading, the axis elongating, (1.5) 2.5–9 cm. long in fruit; *bracts* submembranous becoming scarious, triangular- or lance-acuminate, 1.2–2.7 mm. long; *pedicels* at anthesis ascending, straight or nearly so, 0.8–1.8 mm. long, in fruit a little arched, thickened, (1.2) 1.7–4 mm. long, persistent; *bracteoles* 0–2, minute when present; *calyx* 5.8–8.2 mm. long, strigulose with mixed white and fuscous or black hairs, the subsymmetric disc 1.2–1.3 mm. deep, the campanulate tube 4.2–5 mm. long, 2.5–3.9 mm. in diameter, the subulate or lance-subulate teeth (1.6) 1.8–3.7 mm. long, the whole becoming papery, marcescent unruptured; *petals* greenish-white or cream-colored drying yellowish, or rosy-purple, the banner then with a pale, veined eye; *banner* gently recurved through $\pm 40^\circ$, oblanceolate or rhombic-oblanceolate, notched, 13.4–16 mm. long, 6–8 mm. wide; *wings* 12.5–16.2 mm. long, the claws 5.2–6.4 mm., the linear or linear-elliptic, obliquely erose-truncate or shallowly emarginate, nearly straight blades 8–8.8 mm. long, 1.8–2.3 mm. wide; *keel* 10–11 mm. long, the claws 5.1–6.5 mm., the obliquely half-obovate or triangular blades 4.8–5.7 mm. long, 2.3–2.8 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the sharply deltoid, obscurely porrect apex; *anthers* 0.6–0.8 mm. long; *pod* horizontally spreading or loosely pendulous, technically sessile but elevated on and readily disjointing from a stout, pubescent, stipelike gynophore 3–8.5 mm. long, the body half-ovoid, obliquely fusiform, or lunately half-ellipsoid, bladdery-inflated, 2–4.2 cm. long, (7) 9–15 mm. in diameter, rounded or broadly turbinate at base, contracted distally into a triangular, laterally flattened, erect or somewhat incurved beak 4–8 mm. long, otherwise subterete but shallowly sulcate ventrally, the sutures both filiform, the ventral one varying from straight or even a little concave to slightly less convex than the dorsal one, the thin, pale green or purplish, strigulose valves becoming papery, stramineous, somewhat lustrous, finely but prominently reticulate, not inflexed, the funicular flange obscure, 0–0.2 mm. wide; *dehiscence* apical, after falling; *ovules* 20–26; *seeds* brown, smooth or sparsely punctate, dull, (1.7) 2–2.7 mm. long.—Collections: 16 (o); representative: *Palmer 683* (CAS, ND, NY); *Brandeggee* (from Cedros I.) in 1897 (NY, POM); *J. N. Rose 16,150* (NY); *Ferris 8599* (DS, NY, OB); *Hammerly 79* (CAS, DS, GH); *Wiggins 11,313* (DS).

Open ridges, canyon floors, sandy washes, and gravelly flats, 5–600 feet,

along and near the coast but not confined to the immediate shoreline, local but forming colonies, Cedros Island and adjoining peninsular Baja California about Sebastián Viscaíno Bay, in lat. 28–30° N.—Map No. 112.—January to June; August and September; perhaps intermittently throughout the year.

ASTRAGALUS FASTIDIUS (Kell.) Jones, Contrib. West. Bot. 8: 7. 1898, based on *Phaca fastidia* (haughty, in allusion to the puffed-up pod) Kell. in "Hesperian 4: 145. 1860," the protologue reprinted by Curran in Bull. Calif. Acad. Sci. 1: 136. 1885, cum icone.—"Dr. Kellogg thinks, but cannot be certain, that it came from Cedros Island."—No specimen preserved, the holotypus is probably the Kellogg drawing.—*Astragalus fastidiosus* Greene in Bull. Calif. Acad. Sci. 1: 186. 1885, a pedantic correction. *A. leucopsis* var. *fastidius* (Kell.) Jones, Contrib. West. Bot. 10: 62. 1902.

In general aspect the pompous milk-vetch, *A. fastidius*, resembles *A. trichopodus* var. *lonchus* of sect. *Trichopodi*, like it a maritime astragalus which extends along the Pacific Coast from southern California south to a point in Baja California about one degree of latitude north of the present species. They have been treated in the past as close kindred, but *A. fastidius* differs importantly in the spreading or ascending, not nodding and retrorsely imbricated flowers, and especially in the pod which is jointed to a stipelike gynophore and deciduous when ripe, not continuous with a true stipe and dehiscent on the raceme. The detached pod of *A. fastidius* is scarcely distinguishable in shape or structure from that of several *Inflat*i (for example, *A. allochrous*), and there is already in *A. nutans* an example in the section of a developed gynophore. Although it has no morphological character foreign to the section, *A. fastidius* remains somewhat isolated. It is easily recognized by its canescent stems contrasting with bicolored foliage, numerous leaflets, and swollen, obliquely fusiform or half-ellipsoid fruits.

The plants of *A. fastidius* collected on Cedros Island are alike in having greenish-white or cream-colored petals which dry yellowish, and even if the yellow coloring in Kellogg's figure (as reproduced) is exaggerated, there can be no doubt that the description was correct on this point. On the mainland, in the same latitude and a little northward, the plants are consistently purple-flowered. On the island the gynophore is about 3–4 mm. long, whereas on the mainland it is 6–9 mm. long. It might be desirable to recognize two varieties. The leaflets vary in both areas from glabrous to thinly pubescent on the upper surface, sometimes in one collection (Ferris 8599).

So far as I can learn there is no authentic *Phaca fastidia* extant and even the collector is unknown, although it may have been Dr. Veatch, from whom Kellogg received several Cedros plants. The Kellogg drawing, crude though it is, must serve as holotypus. A good standard of comparison and topotypus, if such be needed, is Greene's collection from Cedros, dated April 29, 1885 (CAS, ND, NY). The combination *A. fastidius* has been attributed above to Jones, for Greene's alteration of the original "*fastidia*" into a theoretically more correct "*fastidiosus*" was in effect a new proposition rather than a simple orthographic variant. Jones assumed that the epithet was intended by Kellogg to carry the primary meaning of *fastidium* as nausea, but this was a mistake. Had the plant been known as ill-scented, poisonous, or otherwise offensive to the senses, Kellogg would have mentioned the fact. On the contrary, the illustration of *Phaca fastidia* carried the caption "Pompous Pea," clearly a translation of *fastidium* in its secondary connotation of excessive pride or haughtiness. I take it to be an example of the gentle humor or fantasy which tradition associates with Kellogg's name. It must rank, nevertheless, among the curiosa of botanical nomenclature.

268. *ASTRAGALUS MAGDALENÆ*

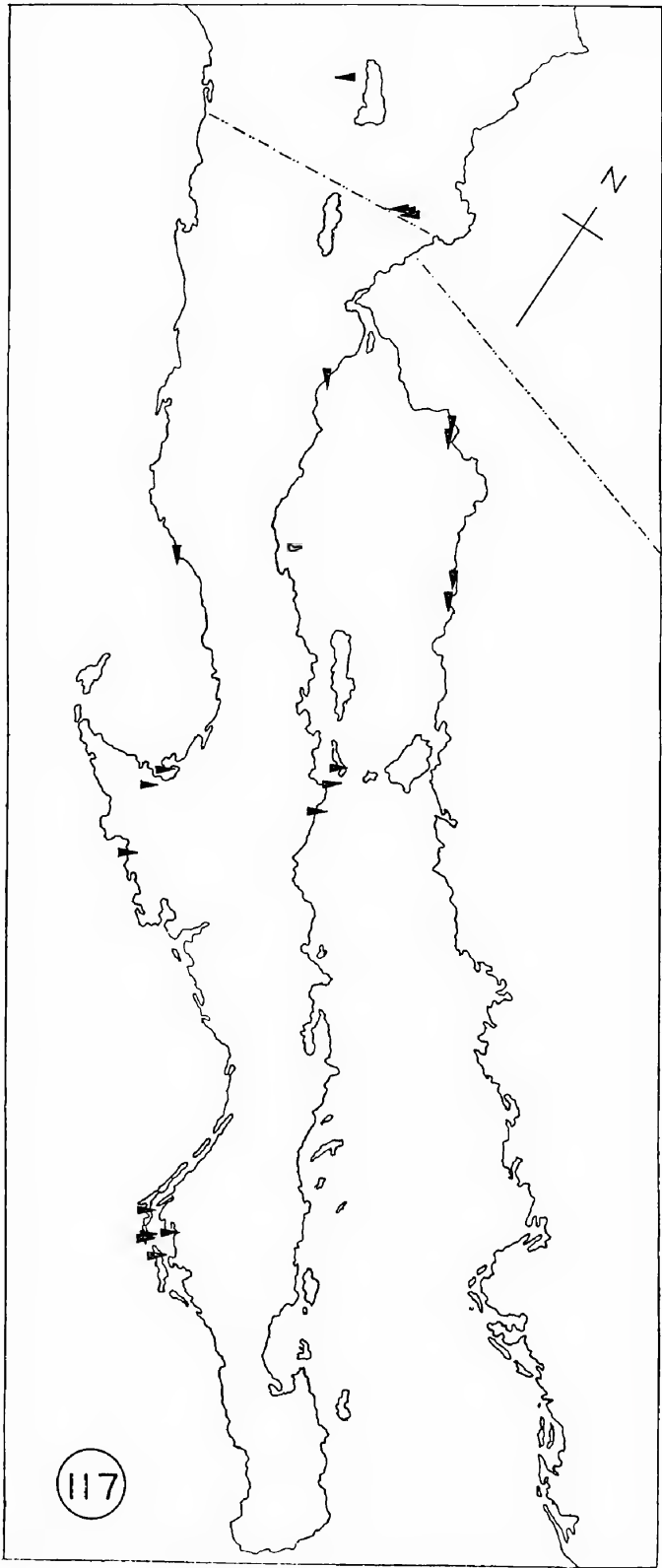
Perennials of comparatively robust stature, maturing rapidly and sometimes of short duration, with a deeply penetrating taproot and ordinarily superficial root-crown sometimes buried in shifting sand, densely strigulose or strigulose-villosulous with fine, short, appressed or subappressed and sometimes some (or many) longer, narrowly ascending hairs up to 0.35–0.95 mm. long, the herbage and stems silvery-canescant or satiny, the herbage rarely greenish-cinereous but silky, the leaflets equally pubescent on both sides, the inflorescence white- or sometimes dark-hairy; stems solitary in seedling plants, eventually several or numerous, erect and ascending in clumps or at length elongating and straggling-decumbent, 2–7 dm. long, spurred or shortly branched at about 5–13 nodes preceding the first peduncle, floriferous in the distal third; stipules submembranous becoming papery and fra-

gile, commonly deciduous in age, triangular, deltoid, or deltoid-acuminate, (1) 2–5.5 mm. long, amplexicaul or decurrent around $\pm \frac{1}{3}$ to the whole stem's circumference, the erect or squarrose blades thinly or densely pubescent dorsally; *leaves* (1) 2–15 cm. long, all petioled or the uppermost sessile, with (3) 9–23 remote or crowded, oblanceolate, linear-oblong, oblong-obovate, obovate-cuneate, or broadly obovate, obtuse or emarginate, rarely obtuse and apiculate, mostly folded or inrolled leaflets 1.5–14 mm. long, the terminal one sometimes confluent with the rachis; *peduncles* erect or incurved-ascending, (2) 3.5–15 cm. long, either longer or shorter than the leaf; *racemes* at first rather densely 10–37-flowered, the flowers at first ascending, spreading in age, the axis somewhat elongating, 2.5–6.5 cm. long in fruit; *bracts* submembranous, triangular, ovate-acuminate, or lanceolate, 1–3 mm. long; *pedicels* at anthesis ascending, 0.4–0.9 mm. long, in fruit more or less arched, thickened, 0.8–1.5 mm. long, persistent; *bracteoles* 0–2, minute, or setaceous and up to 1.5 mm. long; *calyx* 4.3–7.5 (9.2) mm. long, densely silky-strigulose with white or partly black or fuscous hairs, the subsymmetric disc 0.8–1.3 mm. deep, the campanulate tube 3–4 mm. long, 2.6–3.5 mm. in diameter, the teeth subulate, linear- or triangular-subulate, 1.3–3.6 (5.2) mm. long, the whole becoming papery, ruptured, marcescent; *petals* pink-purple, or whitish tipped and margined with pale pinkish-lavender, drying bluish, the banner with a striate eye in the fold, the wing-tips sometimes white; *banner* gently recurved through $\pm 40^\circ$, broadly rhombic-ovate, -obovate, -elliptic, or ovate-cuneate, 9.4–14.2 mm. long, 6.2–10 mm. wide; *wings* 8–13.3 mm. long, the claws 3–4.3 mm., the linear-oblong, oblong-elliptic, or oblanceolate, obliquely truncate or shallowly emarginate, nearly straight blades 5–10.1 mm. long, 2–3 (3.6) mm. wide; *keel* 7.4–10 mm. long, the claws 3–4.3 mm., the half-obovate blades 4.7–6.7 mm. long, 2.5–3.3 mm. wide, incurved through $85\text{--}90^\circ$ to the bluntly deltoid apex; *anthers* 0.5–0.7 mm. long; *pod* spreading, sessile on the slightly elevated receptacle, broadly ovoid, ovoid-ellipsoid, -acuminate, sometimes half-ellipsoid, or subglobose, bladdery-inflated, 1–3.5 cm. long, 1–2.1 (or when pressed apparently to 2.4) cm. in diameter, rounded or broadly turbinate at base, contracted distally into a triangular-acuminate or short and broadly deltoid, laterally compressed beak, shallowly sulcate along the ventral or both sutures, the sutures filiform, either both convex (the ventral one a trifle less strongly so), or the ventral one nearly straight and the dorsal gibbous-convex, the pale green or purple-cheeked, thin-textured, strigulose valves becoming papery, stramineous, subdiaphanous, finely cross-reticulate, not inflexed, the funicular flange 0.8–2 mm. wide; *dehiscence* apical, after falling; *ovules* 10–20; *seeds* brown, sometimes purple-speckled, smooth but dull, 1.6–5.5 mm. long.

The satiny milk-vetch, *A. magdalenae*, is a polymorphic species. As yet there is too little material to permit satisfactory analysis of the racial situation, and the following treatment may require modifying as more data come to light. For the present the whole species or complex may be distinguished from all true *Inflati*, except the fugitive annual *A. aridus*, by its dense, silken or satiny vesture. It is only necessary to beware in coastal Baja California of confusing *A. magdalenae* with *A. anemophilus*, differing in the tomentulose quality of the pubescence and the connate stipules, and to bear in mind that in the southern Colorado Desert *A. magdalenae* var. *Peirsonii* is the only species with decurrent terminal leaflets.

Key to the Varieties of *A. magdalenae*

1. Leaflets 15–23, all jointed to the rachis, the terminal one not longer than the last pair; *peduncles* mostly a little longer than the leaf; *pod* 5–12 mm. in diameter; *seeds* 1.6–3.3 mm. long; coastal dunes from the head of the Gulf of California to the Pacific Coast of Baja California (2)
2. Pods 1.5–2.6 cm. long, 16–20-ovulate; *seeds* 1.6–2.5 mm. long; *petals* apparently bright purple, the banner 9.4–11 mm. long; *stems* typically diffuse; Pacific Coast in lat. $24\text{--}28^\circ$ N. and on the Gulf Coast near $28^\circ 30'$ N. 268a. var. *magdalenae*



2. Pods 1–2 cm. long, 12–14-ovulate; *seeds* 2.5–3.3 mm. long; *petals* apparently pale, only lilac-tinged or -tipped, the banner 11–12.5 mm. long; *stems* typically erect and ascending in clumps; around the head of the Gulf of California in lat. 30–32° N., Baja California and n.-w. Sonora; Pacific Coast at 29° 30' N. 268b. var. *niveus*
1. Leaflets (3) 9–13, the terminal one decurrent and resembling a $\pm$ dilated production of the rachis longer than the last pair of leaflets; *peduncles* mostly a little shorter than the leaf; *pod* 1.3–2.1 cm. in diameter; *seeds* 4.5–5.5 mm. long; inland dunes, in s. Colorado Desert, California (and to be expected in adjoining Arizona and Mexico) 268c. var. *Peirsonii*

268a. ASTRAGALUS MAGDALENAE var. MAGDALENAE

Herbage whitened with a lustrous, satiny vesture of hairs mostly up to 0.35–0.6 (0.65) mm. long; *leaflets* commonly small and crowded, 1.5–10 (15) mm. long; *calyx* 4.3–6.7 mm. long, the tube 3–4 mm., the teeth 1.3–2.7 mm. long; *keel* 7.4–9.6 mm. long; *pod* 1.5–2.6 cm. long, 1–1.3 cm. in diameter, the beak 2.5–8 mm. long.—Collections: 10 (o); representative: *Mason* 1954 (CAS, DS, NY, approximate topotypi), 1967 (CAS); *Brandege* (from Santa Margarita Island) in 1889 (UC); *Orcutt* 29 (NY); *Gentry* 7361 (ARIZ, SD).

Coastal dunes and sandy flats behind barrier beaches, below 20 feet, apparently common locally along the Pacific Coast of Baja California from Scammons Lagoon on Sebastián Viscaíno Bay to Magdalena Bay; on the Gulf Coast at San Francisquito Bay.—Map No. 117.—January to May, probably intermittently throughout the year.

ASTRAGALUS MAGDALENAE (of Magdalene Bay) Greene in Pittonia 1: 162. 1888 (“*Magdaleneae*”), a substitute for *A. candidissimus* (Bth.) Wats., Bibl. Index 191. 1878, a later homonym of *A. candidissimus* Ledeb., 1831, based on *Phaca candidissima* (very white) Bth., Bot. Sulphur 13. 1844.—“Bay of Magdalena.”—Holotypus, labeled “Magdalena, Barclay,” BM!—*Tragacantha californica* (of Baja California) O. Kze., Rev. Gen. 940. 1891. *A. Crotalariae* var. *magdaleneae* (Greene) Jones, Contrib. West. Bot. 10: 59. 1902.

The typical form of the satiny milk-vetch, var. *magdaleneae*, is an attractive plant, recognized with ease by its almost silver-plated stems and foliage combined with sessile, bladdery fruits of moderate size, in these respects unlike any other sympatric coastal astragalus. The material is still too scanty to provide adequate contrasts between the flowers of var. *magdaleneae* and var. *niveus*, but those of the latter appear to be a little larger and less brightly colored. On the Pacific Coast the stems of var. *magdaleneae* are diffuse or trailing, but plants collected by Johnston at San Francisquito Bay on the Gulf side of the peninsula had “strictly ascending” stems (Proc. Calif. Acad. Sci. IV, 13: 1042), thereby simulating var. *niveus* in habit. This possibly distinct form has been referred to var. *magdaleneae* because of its closely appressed, silvery vesture and high ovule-number (18). On the other hand, one collection (*Gentry* 7766, ARIZ, SD) from the Pacific Coast between San Hipolito and Asunción (lat. $\pm$ 27° N.) combines the decumbent growth-habit of var. *magdaleneae* with the small, few-ovulate pod of var. *niveus*. The two varieties seem to be confluent and are, perhaps, not taxonomically separable.

268b. ASTRAGALUS MAGDALENAE var. NIVEUS

Herbage silvery-cinereous, the longest hairs ascending, up to 0.55–0.75 mm. long; *leaflets* as in var. *magdaleneae* but commonly less crowded; *calyx* 5–6.2 mm. long, the tube 3–3.8 mm., the teeth 1.8–2.5 mm. long; *keel* 8.2–9.7 mm. long; *pod* obliquely ellipsoid or half-ellipsoid, 1–2 cm. long, 6–11 mm. in diameter, the beak $\pm$ 2–3 mm. long.—Collections: 6 (o); representative: *Bacigalupi* 2872 (CAS, DS, SMU); *Raven* 11,642A (NY); *Dressler* 595a (MO); *Johnston* 3306 (CAS, K, US).

Dunes and sandy flats behind the beaches, below 40 feet, known from scattered stations around the head of the Gulf of California (San Felipe Bay, Baja

California; Adair and Tepoca Bays, northwestern Sonora); and from the Pacific Coast near 29° 30' N.—Map No. 117.—February to April.

ASTRAGALUS MAGDALENÆ var. *NIVEUS* (Rydb.) Barneby in *Aliso* 4: 135. 1958, based on *Phaca nivea* (snow-white) Rydb. in *N. Amer. Fl.* 24: 328. 1929.—“Type collected 15 miles north of San Felipe Bay, Lower California, February, 1904, *MacDougal* . . .”—Holotypus, collected by D. T. MacDougal, NY!—*A. niveus* (Rydb.) Barneby in *Leaf. West. Bot.* 4: 55. 1944.

The var. *niveus* is closely similar to var. *magdaleneae*, but the somewhat longer and less tightly appressed vesture, less crowded and commonly slightly larger leaflets, slightly longer and paler flowers, and smaller pods containing fewer ovules and fewer but larger seeds provide the rather insecure basis for separating the two. At anthesis the plants of var. *niveus* resemble var. *Peirsonii* in everything except the more numerous lateral and jointed terminal leaflets and in the ordinarily longer peduncles, of which at least the more vigorous surpass the subtending leaf. The much larger pod and seeds of var. *Peirsonii* are distinctive later on. Like var. *magdaleneae*, the present form of the satiny milk-vetch is known only from coastal dunes, but it may extend somewhat inland into the sandy wastes around the Colorado delta. In this area it may overlap the range of the similarly white-silky *A. lentiginosus* var. *borreganus*, an astragalus to be recognized by its very loosely or remotely racemose, larger, bright purple flowers and later by a lunately lanceolate, fully bilocular pod.

268c. *ASTRAGALUS MAGDALENÆ* var. *PEIRSONII*

Herbage silvery-canescens or more rarely greenish-cinereous; *leaflets* distant and scattered along the often flattened and $\pm$ dilated rachis, sometimes greatly reduced in size; *calyx* 5.4–7.5 (9.2) mm. long, the tube 3.5–4 mm., the teeth 1.4–3.6 (5.2) mm. long; *banner* 10–14.2 mm. long; *keel* 8.5–10 mm. long; *pod* 2–3.5 cm. long; *ovules* 11–16.—Collections: 6 (ii); representative: *Jepson 11,720* (UC); *Peirson 7194* (POM); *Ripley & Barneby 10,086* (CAS, RSA).

Slopes and hollows in mobile dunes, usually to the lee of the prevailing winds, 180–800 feet, locally plentiful but known only from two small areas in the southern Colorado Desert, California: Algodones sandhills west of Yuma, Imperial County; Borrego Valley, San Diego County.—Map No. 117.—December to April.

ASTRAGALUS MAGDALENÆ var. *PEIRSONII* (Munz & McBurney) Barneby in *Aliso* 4: 135. 1958, based on *A. Peirsonii* (Frank W. Peirson, 1865–1951, able and enthusiastic amateur botanist, active especially in s. California and the Sierra Nevada) Munz & McBurney ex Munz in *Bull. S. Calif. Acad. Sci.* 31: 67. 1932.—“Type from sand dunes between Holtville and Yuma, Imperial County, *Munz & Hitchcock 12132* . . .”—Holotypus, not located at POM in 1960 but seen there about 1947; isotypi, collected April 5, 1932, G (fragm.), GH, MO, OB!

The Peirson milk-vetch was scornfully dismissed by Jones (1933, p. 37) as synonymous with the very different *A. lentiginosus* var. *Coulteri*. I later reduced it to *A. niveus* (our var. *niveus* above); but in reality it is a distinct and interesting plant, notable for the xerophytic reduction of the foliage and the transformation of the terminal leaflet, which is jointed in all kindred *Inflat*i, into a small phyllode continuous with the often somewhat dilated leaf-rachis. In other respects it is very like var. *niveus*, especially at the flowering stage, and can be interpreted with some assurance as the modified progeny of a maritime type still occupying the old dune habitat but now stranded far inland at the edge of a former lobe of the Sea of Cortez. I have seen one specimen from Adair Bay at the head of the Gulf (G. Sykes 64, US) which suggests var. *Peirsonii* in the obscurely articulate terminal leaflet; but the plant is sterile and, I suspect, would have had the small fruits of var. *niveus* which is known to occur in the vicinity.

On the Algodones Dunes, where it is found in company with a shrubby *Eriogonum*, a few scattered *Larrea*, and the singular root parasite *Ammobroma sonora* Torr., the Peirson milk-vetch is abundant in favorable seasons. After a drought of several years' duration only a few tattered veterans, some of them half smothered and others with a trunklike taproot exposed for a foot or more by the shifting sands, bear witness to a formerly flourishing colony. The plants are potentially perennial but mature rapidly, beginning to bear fruit some two months after germination of the seeds, and thus insure continuation of their sort. The taproot is extraordinarily long, as might be expected under dune conditions, and penetrates deeply before lateral rootlets are produced. In one young plant a simple whiplash root, broken off and incomplete, measured nearly six feet in length, five or six times that of the stem above ground. The ability of the seedling to establish itself high on the leeward side of a swelling dune is

a matter of wonder. Possibly the size of the seeds, the largest known to me in American *Astragalus*, has a bearing on this feat.

No holotypus of *A. Peirsonii* could be found at Pomona College herbarium in 1960, although I have memories of seeing it many years ago. The specimen at POM bearing Munz's annotation is *Peirson 7194*, collected April 15, 1927, which should perhaps be considered at very least a cotypus.

LXIX (iii). Subsectio ARIDI

Annual or biennial, flowering the first season, rarely persisting into a third year; *leaflets* less than 21 (to 23 in *A. Wardi* and *A. endopterus*); *racemes* less than 10-flowered (or if the flowers more numerous than the ovules few); *petals* whitish or purple; *pod* sessile or elevated on a short gynophore, nearly always much inflated, uni- or subunilocular; *ovules* mostly less than 22, if over 20 then the racemes less than 10-flowered.—Spp. 16, of intermontane western United States, the southern Rocky Mountains, and deserts of southeastern California, northern Baja California, Arizona, New Mexico, and western Texas, 1 extending south into southcentral Mexico, 1 north into transmontane Oregon and Wyoming, 1 isolated in eastcentral Idaho.

ASTRAGALUS sect. INFLATI subsect. ARIDI Jones, Rev. Astrag. 92, in clave. 1923.—Sp. typica: *A. aridus* Gray.

Astragalus sect. *Inflati* subsect. *Triflora* Jones, op. cit. 94, in clave. 1923.—Sp. typica: *A. triflorus* sensu Jones (non Gray) = *A. Wootoni* Sheld.

Astragalus sect. *Inflati* subsect. *Allochroi* Jones, l.c. in clave. 1923.—Sp. typica: *A. allochrous* Gray.

Astragalus sect. *Inflati* subsect. *Triquetri* Jones, op. cit. 97, in clave. 1923.—Sp. typica: *A. triquetrus* Gray = *A. Geyeri* var. *triquetrus* (Gray) Jones.

Phaca subgen. *Chartocystis* Rydb. in N. Amer. Fl. 24: 329, in clave. 1929.—Sect. lectotypica: Sect. *Candollianæ* Rydb. = sect. *Inflati* subsect. *Aridi* Jones.

Phaca subgen. *Chartocystis* sect. *Serpentes* Rydb. in N. Amer. Fl. 24: 349. 1929.—Sp. typica: *P. serpens* (Jones) Rydb. = *A. serpens* Jones.

Phaca subgen. *Chartocystis* sect. *Annuae* Rydb. in op. cit. 353. 1929.—Sp. typica: *P. annua* Geyer = *A. Geyeri* Gray.

Phaca subgen. *Chartocystis* sect. *Candollianæ* Rydb. in op. cit. 350. 1929 ("*Candolleanæ*").—Sp. typica: *P. Candolliana* Kunth = *A. Wootoni* var. *Candollianus* (Kunth) Barneby.

Phaca subgen. *Chartocystis* sect. *Pubentissimæ* Rydb. in op. cit. 356. 1929.—Sp. typica: *P. pubentissima* (T. & G.) Rydb. = *A. pubentissimus* T. & G.

Phaca subgen. *Podocystis* sect. *Nutantes* Rydb. in op. cit. 342. 1929.—Sp. typica: *P. nutans* (Jones) Rydb. = *A. nutans* Jones.

The subsection *Aridi* may be characterized in broad terms by comparatively few leaflets, few-flowered racemes of often tiny and inconspicuous flowers, and pods greatly swollen, unilocular, and containing few (less than 20) ovules or seeds. Many individual exceptions to these generalities have been brought out in the synopsis of *Inflati* at the introduction to the section and lead back to the preceding subsect. *Proriferi*. The group as understood here is approximately equivalent to Rydberg's sections *Annuae* and *Candollianæ* of *Phaca*, supposedly separable by the form of the pod; but as the passage from a greatly oblique, ventrally acute pod into one ovoid-ellipsoid and rounded over both sutures is found in the single species *A. insularis*, no practical distinction can be made between them. The *Aridi* consist of true annuals and of perennials of very short and uncertain duration. In some species which are normally annual, certain individuals start as winter-annual and persist through a long spring and summer season, while others, especially in the summer-rainfall areas of the Southwest, germinate in the fall and endure over winter, flowering a second time in the following spring. Plants of these sorts become indurated at base and are often misinterpreted as perennial when served up as dried specimens. Some *Aridi*, however, seem to have a normal life-span of two or three years.

The epithet *Aridi* was chosen from among several candidates of the same date as being the most appropriate, even though the name-bringing species, *A. aridus*, is a highly modified form, by no means central to the subsection, nor typical of the more common type. A better choice of type-species would be *A. Wootoni*, but the subsectional epithet *Triflora* is derived ultimately from a Chilean species and is best avoided in the present context.

269. ASTRAGALUS ALLOCHROUS

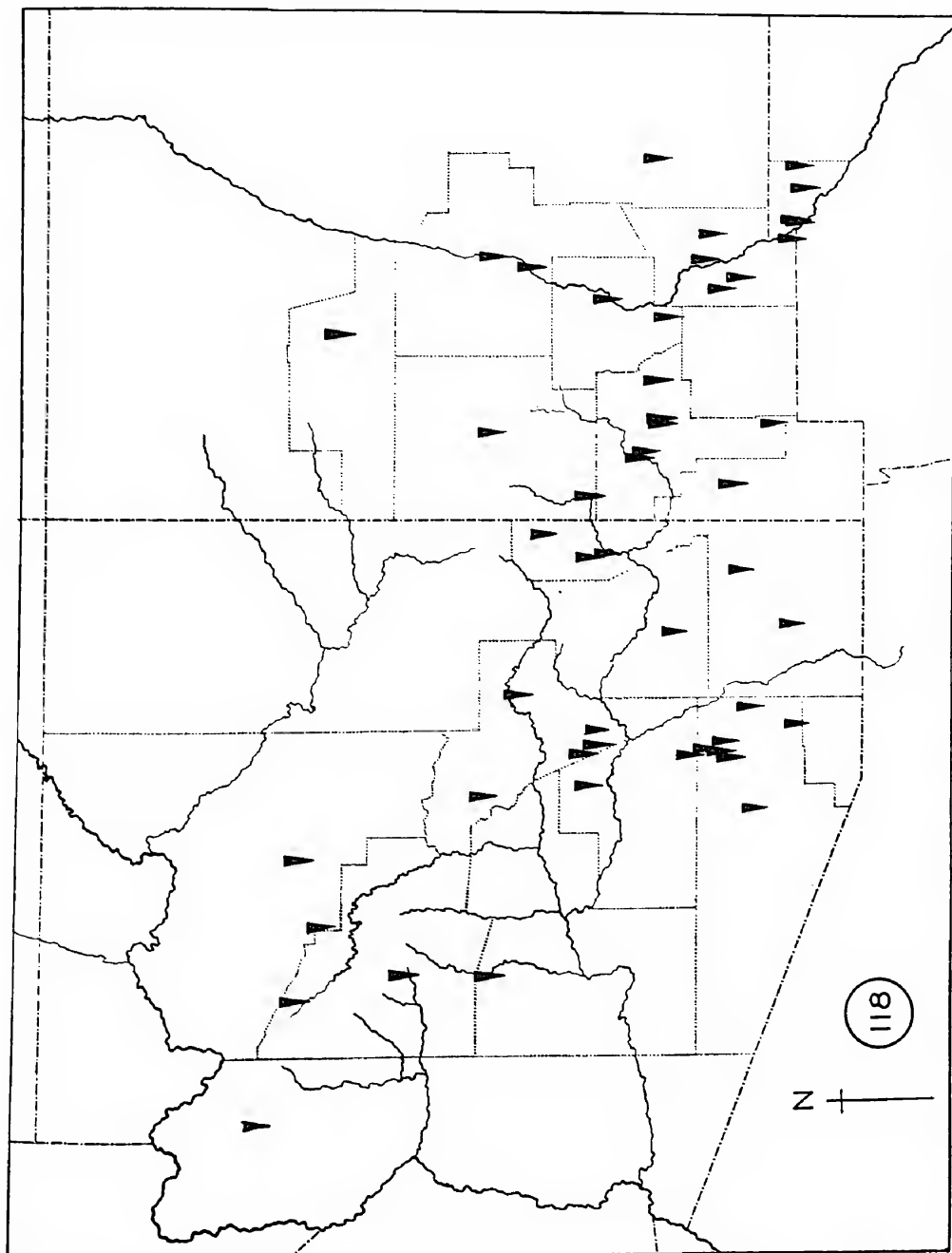
Low, commonly coarse, biennial or short-lived perennial, usually flowering

and often perishing the first summer, strigulose nearly throughout with straight or mostly straight, appressed or subappressed hairs up to 0.45–0.7 mm. long, the herbage green or when young cinereous, the leaflets either pubescent or glabrous above; *stems* several or many, ascending and radiating from the shortly forking root-crown to form low, rounded clumps, the principal ones (1) 1.5–5 dm. long, simple or commonly branched or spurred at 1–several nodes preceding the first peduncle, purplish at base; *stipules* thinly herbaceous or submembranous, the lowest early becoming papery, triangular or ovate-acuminate, 1.5–7 mm. long, decurrent around half, or the lowest around the whole stem's circumference, the margins of the latter ordinarily free, rarely very shortly and obscurely connate (but then more strongly adnate than connate); *leaves* 4–10 mm. long, the uppermost either shortly petioled or subsessile, with (9) 11–21 oblong-obovate, oblanceolate and obtuse or retuse, or (especially in some upper leaves) elliptic or narrowly oblong-elliptic and either obtuse and mucronulate or acute, flat or loosely folded leaflets (4) 6–21 mm. long; *peduncles* incurved-ascending, 3–9 (11) cm. long, commonly shorter, rarely surpassing the leaf; *racemes* loosely 10–20 (30)-flowered, the flowers ascending at anthesis, the axis (1.5) 3.5–12 cm. long in fruit; *bracts* submembranous, pallid or purplish, ovate or lanceolate, 1.2–2.5 mm. long; *pedicels* at anthesis ascending, straight, 1–2 mm. long, in fruit arched outward, a trifle thickened, 2–4 mm. long, persistent; *bracteoles* 2, often minute, attached at or below base of the calyx; *calyx* (3.6) 4.1–5.7 mm. long, strigulose with white or mixed black and white hairs, the subsymmetric disc 0.5–1.1 mm. deep, the campanulate or turbinate-campanulate tube 2.4–3.5 mm. long, 1.9–3.6 mm. in diameter, the lance-subulate teeth (1.1) 1.6–2.5 mm. long, the ventral pair often longest, the whole becoming papery-scarious, ruptured, marcescent; *petals* pink- or reddish-purple, drying violet; *banner* recurved through $\pm 50^\circ$, broadly ovate-cuneate or obcordate, 7.2–9.4 mm. long, (4.9) 5.5–7.2 mm. wide; *wings* 6.6–8.3 mm. long, the claws 2.3–3.1 mm., the obliquely oblong-obovate, broadly obtuse or undulate-erose blades 4.7–5.7 mm. long, 2.2–2.7 mm. wide, both incurved but the left one more abruptly and further than the right; *keel* 6.2–7.5 mm. long, the claws 2.5–3.2 mm., the obliquely triangular blades 3.8–4.5 mm. long, 2.1–2.5 mm. wide, incurved through $\pm 95^\circ$ to the blunt or subacute, slightly porrect apex; *anthers* 0.45–0.55 (0.6) mm. long; *pod* loosely spreading or declined, those of some outer stems often humistrate and ascending, sessile on the slightly elevated receptacle and readily deciduous, very obliquely ellipsoid or half-ellipsoid, bladdery-inflated, (2) 2.5–4 (4.5) cm. long, 1–1.7 (or when pressed apparently to 2) cm. in diameter, obconic at base, contracted ± 3 –6 mm. below the apex into a triangular, compressed, slightly incurved beak, the ventral suture straight or nearly so, the dorsal one strongly convex, the thin, pale green or purple-cheeked, finely strigulose valves becoming papery-diaphanous, stramineous, lustrous, delicately cross-reticulate, not inflexed, the funicular flange 0.4–0.8 mm. wide; *dehiscence* apical, after falling; *ovules* (10) 14–21; seeds brown, ocher- or greenish-brown, sometimes purple-speckled, nearly smooth or irregularly pitted, dull, 2.6–3.2 mm. long.—Collections: 61 (viii); representative: *Peebles* 6862 (ARIZ, NY); *Barneby* 12,624 (CAS, RSA); *Jones* (from Skull Valley) in 1903 (CAS, NY, POM, TEX); *Metcalf* 34 (ND, NMC, NY); *Bigelow*, *Mex. Bound. Surv.* 261 (NY); *Ripley & Barneby* 4210, 11,172, 11,182 (CAS, RSA).

Plains, foothills, and open valleys, on light sandy or gravelly soils of various origin and composition but apparently not or seldom on calcareous bedrock, in desert-grassland, scattered scrub-oak or juniper forest, rarely on dunes, (reportedly 1500) 2000–6200, exceptionally up to 7500 feet, common and locally abundant nearly throughout the Gila River drainage system in central and southeastern

Arizona and southwestern New Mexico, extending sparingly northwest to the Big Williams River in Yavapai County, north in New Mexico to Acomita in Valencia County, and east across the Black Range to the lower Rio Grande Valley in New Mexico and extreme western trans-Pecos Texas; to be expected in adjoining Mexico.—Map No. 118.—April to July, sometimes again in fall.

ASTRAGALUS ALLOCHROUS (of different color, the petals purple as contrasted with those of *A. Douglasii*) Gray in Proc. Amer. Acad. 13: 366. 1878.—“Near Wickenburg, Arizona, Dr. E.



Map No. 118. Arizona and western New Mexico. Range of *A. allochrous*.

Palmer, 1876."—Holotypus (*Palmer 588 in 1876*), GH! isotypi, MO ("Hassayampa Valley"), NY (2 sheets), US!—*Phaca allochroa* (Gray) Rydb., Fl. Rocky Mts. 1063. 1917.

The Hassayampa milk-vetch, *A. allochrous*, is closely related to *A. Wootoni*, differing ideally if not quite consistently in its more robust growth-habit, slightly larger, usually more numerous and always purple flowers, and strongly oblique, half-ellipsoid pods contracted distally into a well-defined beak. The flowers in *A. Wootoni* vary from whitish to purple, but the anthocyanin when present is commonly of a more vinous, reddish, or amethystine tint in the living state; the racemes are seldom over 10-flowered; and the pod is subsymmetrically ellipsoid or subglobose and beakless or nearly so. By virtue of a wider climatic and altitudinal tolerance *A. Wootoni* is the more widely dispersed of the two species, but they are sympatric over a large part of southern Arizona and New Mexico. In the Gila Basin proper, where *A. Wootoni* seems to be commoner on the open plains and *A. allochrous* more abundant in the foothills, the species are almost always clearly distinguished. In the Rio Grande Valley, and along the Mogollon Escarpment in the Colorado drainage, occasional populations or samples of perhaps polymorphic colonies are difficult to assign to either species, some combining the small, whitish flower of *A. Wootoni* with an oblique pod, others a larger, purple flower with symmetric or subsymmetric pod. The great number of specimens collected during the past half-century in Mesilla Valley between Las Cruces and El Paso includes typical material of both species, but also many intermediate forms suggestive of a long period of introgressive hybridization. I have, however, no positive evidence bearing on this point. Judging from these gatherings alone (and occasional but truly rare examples from Arizona) I might be persuaded that only one variable species was involved. To the north, east, and west of *A. allochrous*, however, *A. Wootoni* retains a consistent identity. The relatively numerous flowers and often broad leaflets of the Hassayampa milk-vetch are reminiscent of *A. Douglasii*, with which Gray at first contrasted it; but the latter is Californian, strongly perennial, and differs greatly in the finer details of petal-shape and -proportion, as well as in the easily observed ochroleucous flowers and much more numerous ovules and seeds.

Variation in *A. allochrous*, other than already described in relation to *A. Wootoni*, is scarcely noticeable. In Arizona and immediately adjoining New Mexico the leaflets are pubescent on both sides, whereas farther northward and eastward in New Mexico and Texas the upper surface is glabrous. Although the geographic segregation of the two forms is (to my present knowledge) perfect, they differ too little to be considered as more than minor variants.

From time to time in the past *A. allochrous* has been reported as ranging north to Albuquerque in New Mexico and east to the White Sands, and even into Utah and Colorado. No corresponding specimens have been encountered, and the burden of confirmation must be laid on future exploration. There can be little doubt that the species extends south into Chihuahua, where it may have been collected long ago by the botanists of the Mexican Boundary Survey.

270. ASTRAGALUS WOOTONI

Low but often coarse and leafy, winter-annual or biennial, thinly or when young rather densely strigulose, villosulous, or pilosulous with fine, straight and appressed, narrowly to widely ascending, or incurved-ascending and spreading hairs up to 0.4–0.8 mm. long, the herbage pale green, yellowish-green, or greenish-cinereous, the leaflets glabrous or medially glabrescent above; *stems* sometimes solitary and erect in seedling but already flowering plants, commonly several or numerous from the freely forking, ultimately indurated base, decumbent and incurved-ascending or almost prostrate, (0.35) 0.7–3 (5) dm. long, branched or spurred at most or all nodes preceding the first peduncle, pale green or purplish becoming stramineous; *stipules* submembranous becoming papery, triangular or triangular-acuminate, (1.5) 2.5–7 (10) mm. long, decurrent around half or the lowest more than half the stem's circumference, the latter with contrapetiole margins sometimes contiguous but free, rarely very shortly and obscurely connate (less so than adnate); *leaves* (2) 4–10 (12) cm. long, all shortly petioled or the uppermost subsessile, with (7) 11–23 narrowly oblanceolate, linear-oblong, or oblong-obovate, retuse-truncate or obtuse, often callous-mucronulate, folded or rarely flat leaflets 5–20 mm. long; *peduncles* incurved-ascending, (0.5) 1.5–5.5 (7) cm. long, shorter than the leaf; *racemes* loosely 2–10 (15)-flowered, the flowers

ascending at first anthesis, spreading or declined thereafter, the axis little elongating, (0.5) 1–4 (5) cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–3.2 mm. long; *pedicels* at anthesis slender, ascending, straight or nearly so, 1–2 mm. long, in fruit arched, a trifle thickened, 1.5–3.5 mm. long, persistent; *bracteoles* nearly always 2; *calyx* 4.3–6.4 mm. long, strigulose or villosulous with white or sometimes largely black hairs, the subsymmetric disc 0.5–1.1 mm. deep, the campanulate or turbinate-campanulate tube 2.1–2.9 (3.2) mm. long, 1.8–2.3 mm. in diameter, the lance-subulate teeth 2–3.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish, sometimes tinged with pink or lavender, or pale to vivid reddish-lilac; *banner* recurved through $\pm 45^\circ$, ovate- or obovate-cuneate or flabellate, 4.6–7.5 mm. long, (3.2) 3.5–6 mm. wide; *wings* a trifle shorter or rarely a trifle longer than the banner, (4.1) 4.9–7.5 mm. long, the claws (1.4) 1.6–2.6 mm., the oblong or oblong-obovate, obtuse, sometimes erose-undulate blades (2.9) 3.5–5.6 mm. long, 1.2–2.2 mm. wide, both incurved but the left one further and more abruptly so; *keel* either a trifle shorter or longer than the wings, banner, or both, (4.1) 4.4–6.4 mm. long, the claws 1.5–2.6 mm., the half-obovate or -circular blades 2.7–4.3 mm. long, 1.5–2.4 mm. wide, incurved through 90–100° to the broad and blunt, more rarely triangular and subacute, sometimes obscurely porrect apex; *anthers* (0.25) 0.35–0.5 (0.6) mm. long; *pod* loosely spreading or declined, commonly humistrate (and then often apparently ascending), sessile on the conical receptacle and readily disjoining, broadly and subsymmetrically, or sometimes somewhat obliquely ovoid, ovoid-ellipsoid, ellipsoid, or subglobose, bladdery-inflated, (1) 1.5–3.7 (4.3) cm. long, (0.8) 1.2–2 (or when pressed apparently to 2.4) cm. in diameter, broadly cuneate or rounded at base, contracted just below the apex into a short and obscurely differentiated, deltoid, laterally flattened beak, otherwise subterete or openly and shallowly sulcate along one or both sutures, the sutures filiform, subequally convex or the dorsal one more strongly so, the thin, green or purplish-tinged, very rarely lightly mottled, thinly strigulose, subvillosulous, or glabrate valves becoming papery, stramineous, lustrous, delicately reticulate, not inflexed, the funicular flange none or up to 0.7 (1) mm. wide; *dehiscence* apical, after falling; *ovules* (10) 13–21; *seeds* brown, orange- or purplish-brown, sometimes purple-speckled, roughened, and often sparsely pitted, dull, (2) 2.3–3 mm. long.

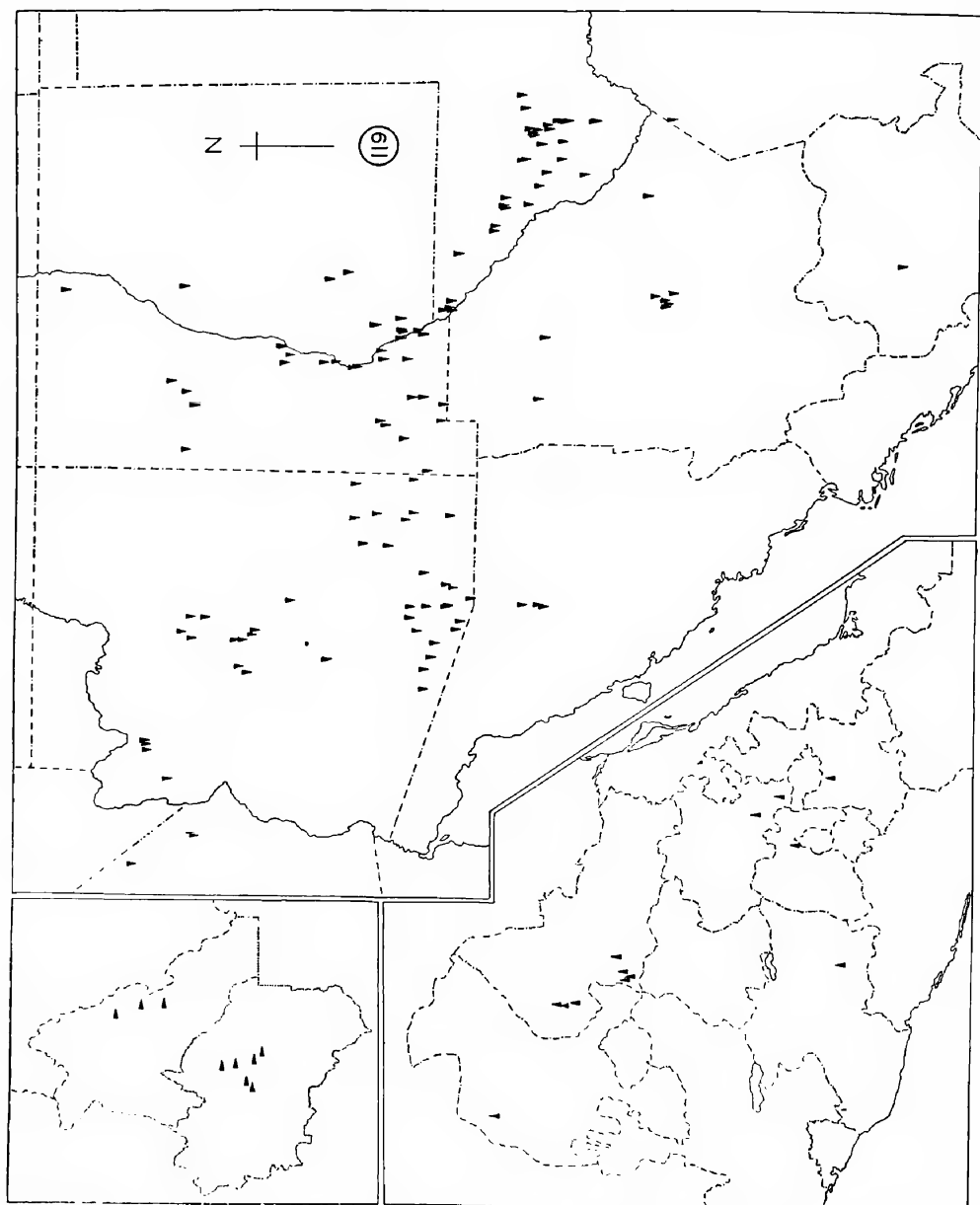
With the exception of the more northern *A. Geyeri*, the Wooton milk-vetch is the most widely dispersed member of its section and is perplexingly variable, most probably composed of several or even many, small geographic races adapted to particular sets of environmental circumstances. My picture of *A. Wootoni* has been pieced together over a period of years. Looking back I suspect that if all the material that has passed through my hands could be reassembled in one place, a more refined perception of the racial structure of the species might be possible. This being at present impracticable, I must limit myself to a brief discussion of the types of variation encountered in the complex.

In the first place the average plant of *A. Wootoni*, although potentially biennial, behaves as an annual during the first season of growth, ordinarily coming into flower within two months of the seed's germination and fruiting soon after. As always with desert annuals, the Wooton milk-vetch varies enormously in stature and luxuriance from year to year according to the amount and timing of the spring rains or thaws. In New Mexico's summer rainfall belt one may find late in the year a colony of old, basally indurated plants intermingled with a new crop of seedlings; and together they exhibit almost the gamut of size-variation known in the whole species. Elsewhere occur colonies of juvenile plants with no sign of a generation dating back to the preceding spring or season, and it is probable that some populations or strains of *A. Wootoni* are obligately monocarpic.

In the United States and northern Mexico the vesture of *A. Wootoni* is ordinarily sparse, appressed or nearly so; in trans-Pecos Texas, and sporadically in southern New Mexico, the hairs become somewhat looser or incurved; and from San Luis Potosi south into Puebla, the herbage is loosely pilosulous with incurved-ascending and spreading hairs. Transition from one extreme type of indumentum to the other is very gradual and does not of itself provide a basis

for varietal segregation. On the higher plains of northern Arizona and New Mexico, the petals are whitish or sometimes faintly roseate, but southward pink- or reddish-lilac flowers become increasingly common, especially on the low sandy deserts along the Rio Grande and in the sahuaro forests of southern Arizona, without anywhere wholly replacing the whitish form. The normal vigorous raceme in northern Mexico and United States is about 5–10-flowered, although counts of 3 up to 15 are on record; southward the flowers are only 2–5. The leaflets of *A. Wootoni* are ordinarily quite narrow, or appear so due to folding of a relatively broad, oblong type, but here and there more amply leafy colonies or individuals have been noticed.

The pod of *A. Wootoni* fluctuates in size between extremes of 1 and 4.3 cm. in length and between 8 and 20 mm. in diameter, but the normal range is smaller, $\pm 1.5\text{--}3.5 \times 1\text{--}1.7$ cm.



Map No. 119. Right, Arizona, New Mexico, Sonora, Chihuahua, and parts of adjoining states; lower left, central Mexico. Range of *A. Wootoni*: $\blacklozenge$ var. *Wootoni*; and $\blacktriangle$ var. *Candollianus*. Upper left, Lemhi and Custer Counties, eastcentral Idaho. Range of *A. aquilonius*.

In general a short pod tends to be plumply ovoid or subglobose; but as increasing length does not go hand in hand with proportionately greater width or inflation, the longest pod assumes a more narrowly elliptic profile. A small pod is commonly encountered on starveling individual plants, but may occur in the most vigorous and amply leafy states, where its size must be governed genetically. Since it is impossible, however, to distinguish in practice between the small-fruited individual from a small-fruited member of a uniform population, I cannot maintain *Phaca Tracyi* which represents a type common in the Big Bend country of western Texas and may be a little more substantial than a casual minor variant. A pod of subsymmetric outline, with sutures almost equally convex, and terminating in an exceptionally short and broad, commonly erect and often obscurely differentiated beak, is the hallmark of *A. Wootoni*, as I conceive the species. Nevertheless it is an easy matter to pick out from any substantial folder of specimens a series of fruits progressively more oblique and more prominently and obliquely beaked until a stage indistinguishable from the pod of *A. allochrous* is reached. Apparent intergradation between *A. Wootoni* and its close relative *A. allochrous*, usually distinguished by its raceme of some 10–20, slightly larger flowers, is discussed under the latter heading.

The Wooton milk-vetch is a pest of rangelands in western Texas and southern New Mexico and Arizona, where it is reported (Kearney & Peebles, 1951, p. 463) as toxic to horses, cattle, and sheep. Both *A. Wootoni* and *A. allochrous* are known to Spanish-speaking shepherds and cowboys as garbanzillo, a term originally applied in Spain to *A. lusitanicus* Lamk. and in South America to *A. Garbancillo* Cav. and related forms. In the New World the term (diminutive of chick-pea) has taken on a generic connotation, being applied widely and indiscriminately by Latin Americans to any astragalus with bladdery fruits.

Key to the Varieties of *A. Wootoni*

1. Vesture of the herbage composed of appressed and straight, or narrowly (in w. Texas and s. New Mexico exceptionally loosely) ascending and straight or nearly straight (sometimes mixed with a few shorter and sinuous) hairs up to 0.4–0.7 mm. long; *racemes* (3) 5–10 (15)-flowered, the flowers less than 5 only in very early or very late racemes or in very young or starveling plants; s.-e. California to n. New Mexico, s. to w. Texas, Chihuahua, Durango, and n.-e. Sonora _____ 270a. var. *Wootoni*
1. Vesture of the herbage loosely villous-pilosulous, the hairs spreading and incurved-ascending, up to 0.6–0.8 mm. long; *racemes* 2–5-flowered; San Luis Potosí to Michoacán and Puebla _____ 270b. var. *Candollianus*

270a. ASTRAGALUS WOOTONI var. WOOTONI

Variable as described for the whole species, except as limited by the key; *leaflets* (7) 11–19; *pod* strigulose.—Collections: 152 (x); representative: *Munz* 16,336 (CAS, POM, WS); *Jones* 3800 (NY, OB, POM), 4424 (NY, OB, POM, TEX); *A. & R. Nelson* 2061 (NY, WS); *Ripley & Barneby* 7577, 10,322 (CAS, RSA); *McVaugh* 7942 (SRSC, SMU, TEX); *Tracy & Earle* 339 (ND, NY, TEX); *E. J. Palmer* 31,037 (CAS, MO); *T. & E. Frye* 2323 (NY); *E. Palmer* 246 in 1908 (MICH, NY, US).

Plains, hillsides, and valley floors, in dry sandy or gravelly soils of varied composition, but apparently commonest on volcanic and granitic bedrock, more rarely on sandstone or limestone, sometimes locally abundant on semistabilized dunes or in disturbed sandy alluvia along highways, 2250–7300 (on the upper Rio Grande up to 8400) feet, in *Larrea* or sahuaro desert, desert- and mesquite-grassland, northward with sagebrush and juniper, widely dispersed and common, northern New Mexico west from the upper Pecos across northern Arizona south of the Colorado River to the extreme eastern Mohave Desert in eastern San Bernardino County, California, south and southeast to northeastern Sonora, Durango, Chihuahua, and trans-Pecos Texas.—Map No. 119.—March to July, sometimes again in late summer and fall.

ASTRAGALUS WOOTONI (Elmer Ottis Wooton, 1865–1945, distinguished interpreter of the flora of New Mexico) Sheld. in Minn. Bot. Stud. 1: 138. 1894 ("wootoni").—"Collected near Las Cruces, New Mexico, May, 1892, by Professor E. O. Wooton."—No *typus* found (but perhaps overlooked) at MINN; presumed *isotypus*, collected in the foothills of the Organ Mountains, Doña Ana County, May 15, 1892, NY!—*Phaca Wootoni* (Sheld.) Rydb. in N. Amer. Fl. 24: 350. 1929. *A. Wootoni* var. *typicus* Barneby in Amer. Midl. Nat. 41: 498. 1949.

Astragalus playanus (of desert playas) Jones, Contrib. West. Bot. 8: 6. 1898.—“The types are the specimens of the writer’s collection of 1884 from El Paso, from New Mex. and Ariz. and all specimens referred to in Cont. vii 637 [i.e., in Proc. Calif. Acad. Sci. II, 5: 1.c.] under *triflorus* . . .”—Lectotypus (Barneby, 1941, p. 498), collected at El Paso, Texas, Jones in 1884, POM!—*A. triflorus* var. *playanus* (Jones) Jones, Rev. Astrag. 106. Pl. 11. 1923.

Phaca Tracyi (Samuel Mills Tracy, 1847–1920, plant breeder, agronomist, mycologist) Rydb. in N. Amer. Fl. 24: 351. 1929.—“Type collected on Toyah Creek, western Texas, April 21, 1902, Tracy & Earle 78 . . .”—Holotypus, NY! isotypi, ND, NY, MO, TEX, US!—*Astragalus Tracyi* (Rydb.) Cory in Rhodora 38: 406. 1936.

Astragalus triflorus sensu Gray in Pl. Wright. 2: 45. 1853 & in Proc. Amer. Acad. 6: 214. 1864, pro parte, exclus. syn. Kunth., basionym., et specimine Coulteri; sensu Torr., Bot. Mex. Bound. Surv. 56. 1859; et auct. al. bor.-amer.; non *A. triflorus* (DC.) Gray, sens. strict., nec *Phaca triflora* DC.

With one important exception the typical form of the Wooton milk-vetch is the only astragalus within its area of dispersal in which flowers as few and nearly as small are combined with pods at once greatly inflated, sessile, deciduous, and unilocular. The exception is *A. allochrous*, which is found over considerable areas in the Southwest, sympatric and in places apparently confluent with it. The ideal differences have been stressed above in the sectional key, but cf. the discussion of *A. allochrous* for a more discursive account. At the edge of its range the Wooton milk-vetch approaches that of several related and morphologically similar species: in Coconino County, Arizona, the rare *A. endopterus*, distinguished by its few (7–11) leaflets and many-ovulate pod with an extraordinarily broad funicular flange within; in the Mohave Desert, California, and extreme western Arizona, *A. nutans* and *A. insularis* var. *Harwoodii*, which differ from the nearly sympatric phase of *A. Wootoni* in their purple flowers and strongly oblique, prominently beaked fruits; and in northern New Mexico, *A. cerussatus*, easily recognized in practice by its villosulous herbage and narrowly septiferous pod. Other close relatives of *A. Wootoni* are the larger-flowered *A. aquilonius* of eastcentral Idaho, the almost glabrous *A. Wardi* of Utah, and *A. Gilmani* endemic to the Death Valley region. Among the *Inflatii* only one other, *A. insularis* var. *quentinus*, localized on and near the Pacific Coast of northern Baja California, is characterized by a subsymmetric, nearly beakless pod, but this differs in its acute leaflets, shorter calyx-teeth, and few (8–10) ovules.

The var. *Wootoni* was first collected in the summer of 1852 by Charles Wright, whose specimens (No. 1361) are labeled alternatively “New Mexico” or “Sandy banks of the Rio Grande below El Paso,” either in Texas or possibly in Chihuahua, where Josiah Gregg encountered it shortly afterward. This material was interpreted by Gray (Pl. Wright, 1.c.) as conspecific with the Mexican *Phaca Candolliana* Kunth, which had previously been equated by DeCandolle with his own Peruvian *P. triflora*; and the name *A. triflorus* persisted in the North American literature up to the time of Jones’s Revision (1923). The Wright gathering was among the elements referred to obliquely by Jones when he described *A. playanus*.

270b. ASTRAGALUS WOOTONI var. CANDOLLIANUS

Essentially as in var. *Wootoni* except for the villosulous vesture and few-flowered racemes; leaflets often slightly more numerous, up to 23; pod loosely strigulose or in age (? sometimes truly) glabrous except for a line of hairs along the ventral suture.—Collections; 14 (i); representative: Parry & Palmer 173 (GH, NY); Schaffner 187 (NY); Rose & Hough 4558 (US); Arsène 10,061 (NY); Ripley & Barneby 13,463 (NY, RSA).

Dry hills, plains, valley floors, $\pm$ 2900–8200 feet, apparently not common, southcentral Mexico (Puebla and Valley of Mexico) west to Michoacán, north to San Luis Potosí and perhaps western Coahuila.—Map No. 119.—April to August, sometimes again from July to November.

ASTRAGALUS WOOTONI var. CANDOLLIANUS (Kunth) Barneby in Amer. Midl. Nat. 41: 498. 1949 (“*Candolleanus*”), based on *Phaca Candolliana* (Augustin Pyramus de Candolle, 1778–1841, one of the first systematic students of *Astragalus*) Kunth in H. B. K., Nov. Gen. & Sp. (folio) 6: 387, Tab. 586. 1824 (exclus. syn. Candoll.).—“Crescit in monte ignivomo Jorullo, alt. 480 hex.”—Typus, collected by Humboldt and Bonpland in 1803, P (herb. Humb.)! isotypus, P (herb. Bonpl.)! phototypus, labeled “Jorullo, donné par M. A. Bonpland,” US!—*Astragalus Candollianus* (Kunth) Sheld. in Minn. Bot. Stud. 1: 140. 1891 (non *A. Candolleanus* Royle ex Bth. in Royle, Ill. Himal. 199. 1835). *A. triflorus* var. *Candollianus* (Kunth) Jones in Proc. Calif. Acad. Sci. II, 5: 637. 1895 (“*Candolleanus*”).

Phaca zacatecana (of Zacatecas) Rydb. in N. Amer. Fl. 24: 352. 1929.—“Casualidad,

Zacatecas, April 26, 1892, M. E. Jones . . ."—Holotypus, NY! isotypi, MO, POM (Jones 146, 2 sheets), US! (non *A. zacatecanus* (Rydb.) Barneby).

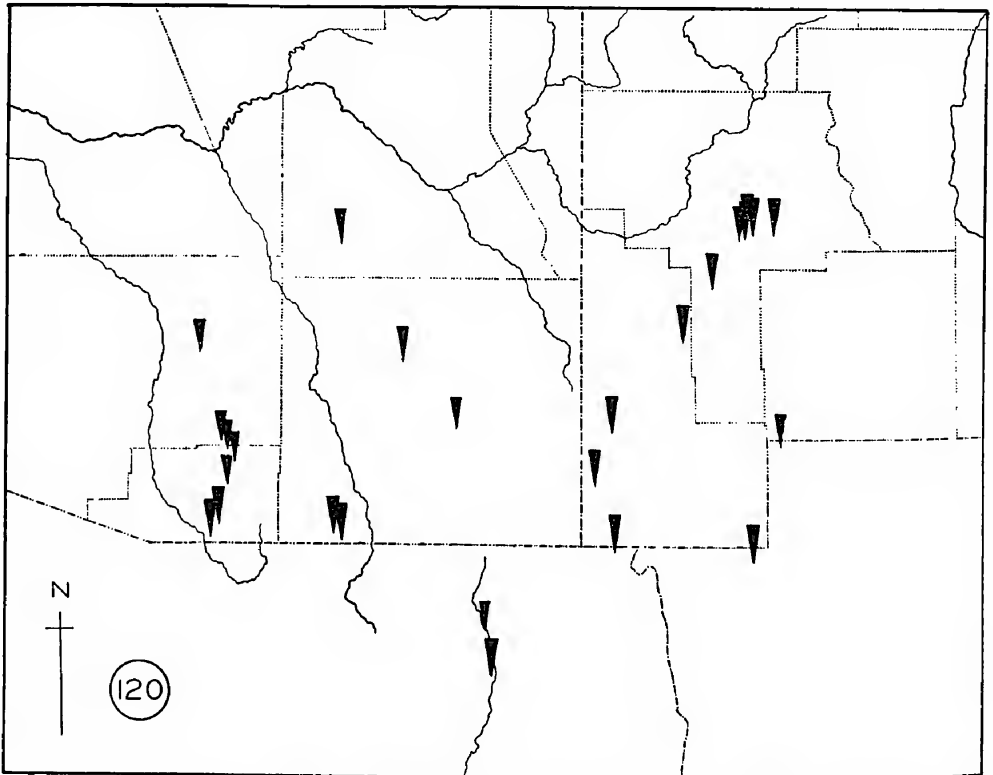
The var. *Candollianus* is not set off from its commoner relative var. *Wootoni* by any single differential character consistently correlated with a southern origin. It is rather the combination of villosulous vesture with small, often glabrescent pods and few-flowered racemes which serves to mark the whole southerly population as distinct. Humboldt's plant is said to have a truly glabrous ovary (not checked) and must have come from below 3000 feet elevation, but there is no subsequent collection from below 5000 feet and none with a truly hairless gynoeceum. In the Valley of Mexico the pod is nearly hairless at maturity, but traces of pubescence persist along the ventral suture even at the fully ripe stage (cf. Arsène 10,061, NY). Ordinarily the pod is thinly and loosely strigulose over the whole surface. The var. *Candollianus* was collected first late in the XVIII century by Sessé or his collaborators in Mexico (herb. Sessé & Mocino 3750bis, MA).

The validity of the epithet *Candollianus* as applied to our plant is open to challenge, since Kunth in the protologue of *P. Candolliana* identified his species with the Peruvian *P. triflora* DC. (Astragalogia, Pl. 1. 1802). It would be possible to regard *P. Candolliana* as an illegitimate substitute, but I agree with Johnston (1947, p. 392) that Kunth's name should be reserved for the plant which he actually saw and described, whereas *A. triflorus* (DC.) Gray (Pl. Wright. 2: 45. 1853) is available for the Peruvian species. Gray was misled by Kunth and by DeCandolle himself (Prod. 2: 74. 1825) into believing the North and South American species conspecific, and in the first instance employed the combination *A. triflorus* in the sense of our *A. Wootoni*. If Johnston's opinion proves unacceptable, we can perhaps conserve the epithet in the present sense and rank by tracing it no further back than *A. triflorus* var. *Candollianus* Jones (1895). Following Gray, the majority of botanists up to recent times have treated *A. Wootoni* (sens. lat.) under the name *A. triflorus*, although it should not be overlooked that Gray himself (1864, p. 214) subsequently quoted the Candollian basionym as a doubtful synonym of his *A. triflorus* (our var. *Wootoni*). The consequences of the taxonomic and nomenclatural confusion surrounding the two names *Phaca triflora* and *P. Candolliana* are more absurd than interesting. Sheldon attempted to pass off a new *A. triflorus* (DC.) Sheld. (non Gray) for the Peruvian plant and a new *A. Candollianus* (Kunth) Sheld., twice over a later homonym, for the Mexican one. And in order to squeeze his North American "*A. triflorus*" into the original Peruvian *Phaca triflora*, Jones resorted to a baseless accusation of inaccuracy on DeCandolle's part, stigmatizing the beautifully exact figure in *Astragalogia* as a product of fancy. The true *A. triflorus* is only superficially similar to *A. Wootoni*, differing in its connate stipules, few leaflets, and smaller, less swollen pod.

271. ASTRAGALUS THURBERI

Low and diffuse, rather coarse, perennial but of short duration, sometimes flowering and fruiting the first year, with a taproot and at length indurated root-crown, strigulose nearly throughout with straight, appressed or subappressed hairs up to 0.35–0.55 mm. long, the herbage green, the growing tips sometimes cinereous, the leaflets glabrous above; *stems* several or numerous, decumbent and ascending in low bushy clumps, (0.7) 1.5–4 dm. long (in seedlings sometimes solitary, erect, already fruiting when only 3–4 cm. tall), striate, spurred or branched at 1–3 (5) nodes preceding the first peduncle, flexuous or zigzag distally; *stipules* (2) 3–8 mm. long, the lowest early becoming papery, deltoid-ovate, the upper ones longer and narrower, submembranous, triangular or triangular-acuminate, decurrent around half to nearly the whole stem's circumference, the margins commonly beset with a few minute processes; *leaves* (2) 4–10 (11.5) cm. long, all petioled but the uppermost shortly so, with (9) 13–21 oblong-elliptic, oblanceolate, or linear-elliptic, obtuse, truncate and mucronulate, or shallowly retuse, flat or loosely folded leaflets 5–15 (18) mm. long; *peduncles* commonly rather stout, erect or incurved-ascending, 3–8.5 mm. long, a little shorter or longer than the leaf; *racemes* (7) 10–25 (32)-flowered, rather dense in early anthesis, becoming loose in age, the flowers ultimately spreading, the axis (2) 3–7 (11) cm. long in fruit; *bracts* lanceolate, broadly membranous-margined, 1–2.4 mm. long; *pedicels* at anthesis ascending, straight, 0.5–1 mm. long, in fruit arched outward, a trifle thickened, 1–1.8 mm. long, persistent; *calyx* 3.3–5 mm. long,

strigulose with white and sometimes a few black hairs, the slightly oblique, turbinate disc 0.6–1 mm. deep, the tube 2.2–2.9 mm. long, 1.7–2.2 (2.5) mm. in diameter, the erect, subulate or lance-subulate teeth (1) 1.3–2.3 mm. long, the ventral pair often longest, the whole becoming papery, ruptured, marcescent; *petals* reddish-lilac or -purple; *banner* at full anthesis recurved through $\pm 50^\circ$ (sometimes further in withering), 5.7–7.1 mm. long, the short-cuneate claw abruptly expanded into a broadly ovate or suborbicular, shallowly notched blade 4.2–5.7 mm. wide; *wings* 5.1–6.7 mm. long, the claws 1.8–2.5 mm., the oblong-obovate, obtuse but often erose-undulate, slightly incurved blades 3.6–4.8 mm. long, 1.6–2.3 mm. wide; *keel* 4.7–5.6 mm. long, the claws 2.2–2.7 mm., the half-circular or -obovate blades 2.6–3.4 mm. long, 1.7–2 mm. wide, abruptly incurved through $100\text{--}105^\circ$ to the obtusely deltoid, sometimes obscurely porrect apex; *anthers* 0.35–0.55 mm. long; *Pods* crowded and subcontiguous in narrowly oblong or cylindrical heads, spreading or a little declined, sessile on and disjointing from the conic receptacle, the body very broadly and plumply ovoid- or obovoid-ellipsoid, obovoid, or subglobose, bladdery-inflated, 6–13 mm. long, 6–10 mm. in diameter, rounded at base, contracted distally into a very short or subobsolete, triangular beak, obscurely or not at all sulcate along the subequally convex sutures, the thin, green or minutely purple-dotted, sparsely strigulose valves becoming papery, stramineous, delicately cross-reticulate, not inflexed, the funicular flange 0.3–0.6 mm. wide; *dehiscence* apparently apical, tardy, after falling, *ovules* 8–11; *seeds* golden- or ocher-brown, smooth or sparsely pitted, dull, 1.7–2.4 mm. long.—Collections: 32 (ii); representative: *Jones* 26,184 (ARIZ, CAS, POM), 26,185 (CAS, POM,



Map No. 120. Southeastern Arizona, southwestern New Mexico, and parts of adjoining Mexico. Range of *A. Thurberi*.

WS); *A. Nelson 1587* (NY, TEX, WS); *Eggleston 19,949* (CAS, NY); *Barneby 11,173* (CAS, NY, RSA, WS); *Wiggins 11,780* (DS).

Plains, valleys, open hillsides, in dry sandy or gravelly soils, sometimes on semistabilized dunes, with *Larrea*, oak brush and juniper, or in mesquite-grassland, without apparent rock preference, 3000–6000 feet, rather common and locally abundant in favorable years, southeastern Arizona, southwestern New Mexico, and northeastern Sonora, presumably in adjoining Chihuahua.—Map No. 120.—March to May.

ASTRAGALUS THURBERI (George Thurber, 1821–1890, botanist with the Mexican Boundary Survey in the 1850's) Gray in Mem. Amer. Acad. II, 5 (Pl. Thurb.): 312. 1854.—“Near Fronteras, &c., Sonora; in dry places; June, 1851. No. 327.”—Holotypus (*Thurber 372*), GH! Istoypi, K, NY (2 sheets)!—*Tragacantha Thurberi* (Gray) O. Kze., Rev. Gen. 948. 1891. *Phaca Thurberi* (Gray) Kearn. in Trans. N. Y. Acad. 14: 34. 1894.

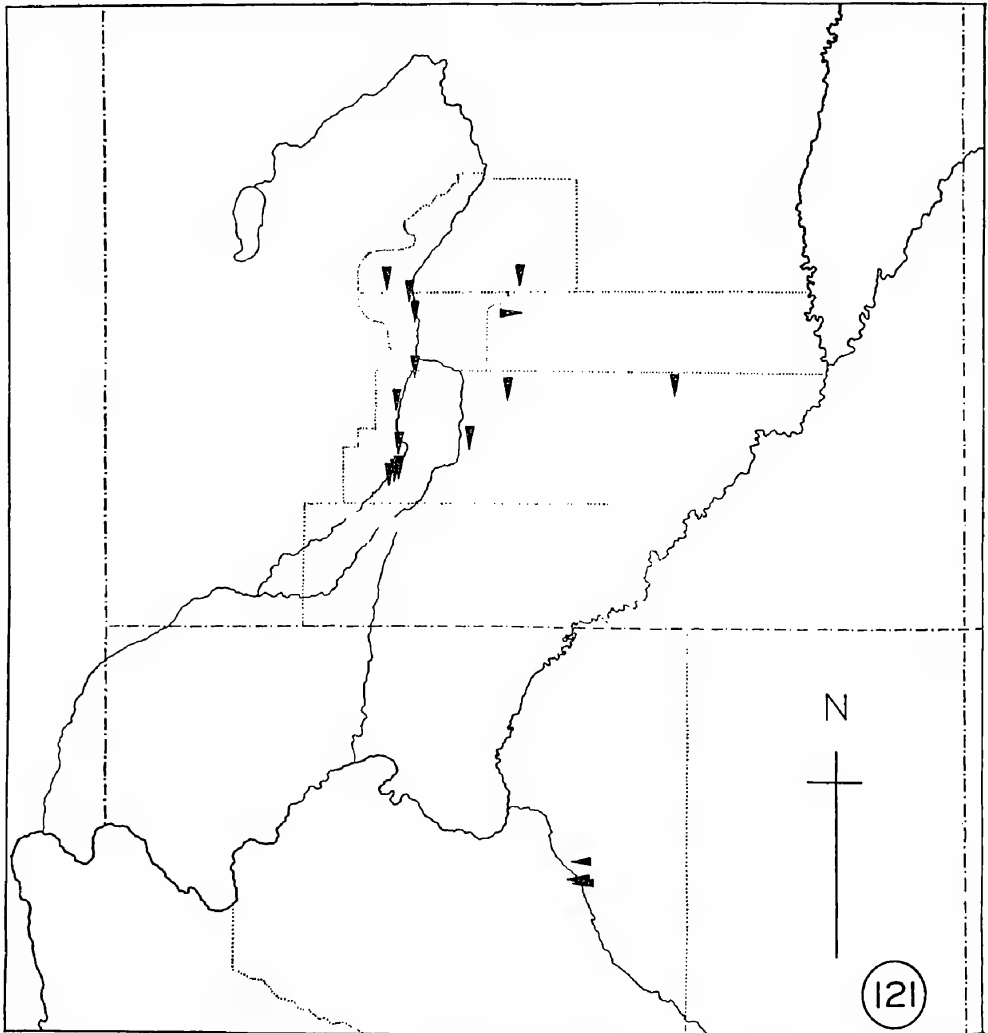
Flowering specimens of the Thurber milk-vetch suggest a form of *A. Wootoni* with twice as many flowers to the raceme; growth-habit and details of foliage, vesture, and parts of the flower up to the reduced number of ovules in *A. Thurberi* are closely similar in the two species. Fortunately both of them flower and bear fruits early in the season, when the Thurber milk-vetch is readily told from the related and partly sympatric *A. Wootoni* and *A. allochrous* by its comparatively tiny, plumply obovoid or subglobose pod. The species is locally abundant in parts of southeastern Arizona and adjoining New Mexico, where it has the reputation of being highly poisonous, especially to horses.

The Thurber milk-vetch was identified by Jones (1933, p. 45) with a South American member of sect. *Inflati*, *A. coquimbensis* (H. & A.) Reiche, a species of coastal desert in northern Peru which is similar in gross aspect but differs in many details. The root of *A. coquimbensis* appears to be truly annual and always short-lived, the raceme is only about 7–10 (not on the average 10–25)-flowered and the flowers themselves are slightly but significantly larger. Furthermore the pods are fewer, less crowded, and larger (about $12-25 \times 8-15$, not $6-13 \times 6-10$ mm.) and the ovules more numerous (12–17, not 8–11). The pod of *A. coquimbensis* apparently falls together with the pedicel as in the other South American *Inflati* and not, as in *A. Thurberi*, by disjoining from the receptacle. The relationship is evident but not really close.

272. *ASTRAGALUS WARDI*

Perennial of short duration, with a taproot and knotty or shortly forking caudex, thinly strigulose with appressed or narrowly ascending hairs up to 0.3–0.5 mm. long, the herbage green, the leaflets pubescent only along the margins and midrib beneath; *stems* several, decumbent or ascending, purple-tinged, 1–3 (3.5) dm. long, either simple and floriferous from below the middle or bearing branches or spurs at 1–3 (5) axils preceding the first peduncle, together forming loose clumps of low, rounded outline; *stipules* submembranous, 1–3 mm. long, the lowest early becoming papery and brownish, broader than long, decurrent around $\pm \frac{3}{4}$ the stem's circumference, the rest deltoid or triangular, squarrose; *leaves* 3–8 (10) cm. long, the lowest slender-petioled, the upper ones subsessile, with (11) 17–23 elliptic-oblong, narrowly elliptic, or linear-oblong, obtuse or retuse, rarely obcordate, loosely folded leaflets 3–8 (11) mm. long; *peduncles* incurved-ascending, slender or subfiliform, 1.5–3 (5) cm. long, much shorter than the leaf; *racemes* loosely 5–12 (15)-flowered, the flowers at first ascending, ultimately declined, the axis (1) 1.5–4 (5) cm. long in fruit; *bracts* membranous, lance-ovate, 1–2.2 mm. long; *pedicels* at anthesis slender, ascending, 1–1.7 mm. long, in fruit abruptly divaricate, arched and twisted, or deflexed, a little thickened, 2.2–3.4 mm. long; *bracteoles* 0–2, when present attached at or below the base of the calyx; *calyx* 2.9–4.6 mm. long, thinly strigulose with black, white, or mixed hairs, the subsymmetric disc 0.4–0.6 mm. deep, the submembranous, often pinkish tube 1.7–2.3 mm. long, 1.6–2.1 mm. in diameter, the narrowly subulate, erect but commonly incurved teeth (1) 1.4–2.4 mm. long, the whole becoming papery,

ruptured, marcescent; *petals* whitish or greenish-white, faintly pink-veined; *banner* abruptly recurved through nearly 90° , broadly elliptic-oval or ovate-cuneate, 5.2–7.4 mm. long, 3.4–5 mm. wide; *wings* nearly as long or a trifle longer, 5.3–7.1 mm. long, the claws 1.6–2 mm., the lance-elliptic, obtuse blades 4–5.6 mm. long, 1.6–2.1 mm. wide, both incurved but the left one more strongly so, often through nearly 90° , and its inner margin infolded; *keel* 3.9–4.6 mm. long, the claws 1.6–2 mm., the broadly half-ovate or half-circular blades 2.3–3.1 mm. long, 1.4–1.8 mm. wide, abruptly incurved through 100 – 110° to the bluntly deltoid, often obscurely porrect apex; *anthers* 0.35–0.45 mm. long; *pod* pendulous or loosely spreading, sessile on the scarcely produced receptacle, subsymmetrically ovoid-ellipsoid, bladdery-inflated, 1.5–2.8 cm. long, 0.9–1.4 (or when pressed seemingly up to 1.7) cm. in diameter, rounded or obconic at base, contracted distally into a very short, broadly deltoid, laterally compressed beak, otherwise a trifle obcompressed, shallowly sulcate ventrally, the thin, glabrous, nearly always mottled valves becoming papery-membranous, stramineous, semitransparent, delicately reticulate,



Map No. 121. Southern Utah and northern Arizona. Range of ▲ *A. Wardi*; of △ *A. endopterus*; and of ⚡ *A. serpens*.

the funicular flange 0.7–1.1 mm. wide; *ovules* 12–14 (17); *seeds* soot-black or dark purplish-brown, almost smooth but dull, 1.9–3.1 mm. long.—Collections: 19 (v); representative: *Rydberg & Carlton 7387* (NY, WIS); *Jones 5397i, 5684p, 5989c* (NY, POM); *Ripley & Barneby 8535, 8582* (CAS, RSA).

Dry hillsides, bluffs, canyon benches, sometimes on sand bars of summer-dry streams, in gravelly alluvia of varied origins, 5300–8000 (reportedly 9000) feet, locally plentiful along both forks of the Sevier River upstream from Richfield, and east to the Henry Mountains, southcentral Utah.—Map No. 121.—May to September.

ASTRAGALUS WARDI (Lester Frank Ward, 1841–1913, botanist and geologist with U. S. Geological Survey, in Utah with Major Powell's party in 1875) Gray in Proc. Amer. Acad. 12: 55. 1877.—“Sevier Co., Utah, on the edge of Aquarin's [properly Aquarius] Plateau, at 8,700 feet, Lester F. Ward in Powell's Expedition.”—Holotypus (*Ward 424*), collected July 25, 1875, GH! isotypi, K, NY, PH, US!—*Phaca Wardi* (Gray) Rydb. in Bull. Torr. Club 40: 47. 1913 (“*Wardii*”).

The Ward milk-vetch is one of those species which lack any single differential character important in the context of its group, but is endowed with enough small features to form a distinctive and even visually striking combination. Its flowers and pods are not significantly different in form from those of *A. Wootoni*, *A. endopterus*, or several other related species; but the comparatively many small and scattered, subglabrous leaflets of a yellow-green color, the tiny, white flowers spaced out along an almost threadlike axis as long or commonly longer than the peduncle, and the truly glabrous, prettily red-mottled pods of semitransparent texture furnish the plants with an individual facies more marked than a formal description would suggest. The Sevier Valley and plateaus of southern Utah are rich in astragali with small flowers and bladdery, unilocular fruits, but none need be confused with *A. Wardi*. Among them *A. (Scytocarp) subcinereus*, *A. (Monoenses) Perianus*, and *A. (Jejuni) limnocharis* have connate stipules and the first two of them subterranean caudices; they need detain us no further. Only *A. serpens* of sect. *Inflati* is sympatric or nearly so with *A. Wardi*, and this is easily recognized by its loosely hairy foliage and purple or at least purplish flowers with narrowed keel-tip. Its pod is similar to that of *A. Wardi* but thinly pubescent and elevated on a stipelike gynophore about 1 mm. long.

The known dispersal of *A. Wardi* is compact and natural and no great extensions can be expected. Jones reported (1923, p. 107) a doubtful record from Willow Springs on the Moencoppa in northern Arizona, but his specimens represent *A. endopterus*. The habitat “along irrigation ditches and moist bare bottoms and among willows” given by Jones (l.c.) is misleading. The Ward milk-vetch is sometimes found on loose gravels thrown out in the course of constructing irrigation flumes, and it also seeds down into sand or gravel bars on the valley floor from the slopes and benches above. It is nevertheless by nature xerophytic, most frequent and vigorous, I think, on cobblestone alluvia laid down by torrents in the past.

273. ASTRAGALUS AQUILONIUS

Commonly robust and rather coarse, perennial but of short duration, with a stout taproot and knotty root-crown or shortly forking, indurated caudex, strigulose-villosulous with fine, loosely ascending or incumbent hairs up to 0.5–0.75 mm. long, the herbage greenish-cinereous or the young leaves subcanescent, the leaflets medially glabrescent above; *stems* several or numerous, decumbent or weakly assurgent, (1) 2–3.5 dm. (or in occasional precociously flowering seedlings only 0.4 dm.) long, usually purple-tinged, simple or branched from 1–3 axils preceding the first peduncle, together forming clumps of low, rounded outline; *stipules* 2–4 mm. long, submembranous, purplish, the lowest early becoming papery and brownish, mostly broader than long, amplexicaul-decurrent around $\frac{1}{2}$ – $\frac{2}{3}$ the stem, the median and upper ones narrower, with triangular or lanceolate, mostly erect blades; *leaves* 4–9 cm. long, all petioled but the upper ones shortly so, with (11) 15–19 (23) oval, elliptic-obovate, or broadly oblanceolate, obtuse or shallowly retuse, flat leaflets (4) 5–18 mm. long; *peduncles* incurved-ascending, (3) 4–6.5 cm. long, shorter than the leaf; *racemes* loosely 5–9-flowered, the flowers ascending and declined in age, the axis 1.5–5.5 cm. long in fruit; *bracts* submembranous,

lanceolate or lance-acuminate, 1.5–2.5 mm. long, commonly purplish; *pedicels* very slender, at anthesis ascending at a wide angle, 2–4 mm. long, in fruit usually straight and divaricate but sometimes arched or twisted following the orientation of the humistrate pod; *bracteoles* 0–2; *calyx* 6.7–7.8 mm. long, loosely strigulose with white and fuscous hairs, the subsymmetric disc 0.8–1 mm. deep, the tube 3.7–3.9 mm. long, (2.2) 2.9–3.3 mm. in diameter, the slenderly subulate teeth 2.8–4 mm. long; *petals* greenish-white, often tinged or veined with dull lilac; *banner* recurved through 60–90°, ovate-cuneate or somewhat rhombic in outline, shallowly emarginate, 9.5–11 mm. long, 6–8.5 mm. wide; *wings* 8.6–9.5 mm. long, the claws 3.4–3.6 mm., the obliquely obovate, obtuse or obscurely emarginate blades 5.7–6.6 mm. long, 2.4–3.2 mm. wide, both incurved but the left one more strongly so and its inner margin infolded; *keel* 7.8–8.9 mm. long, the claws 3.5–3.8 mm., the lunately half-elliptic blades 4.7–6 mm. long, 2.1–2.8 mm. wide, incurved through 80–90° to the triangular, subacute, often obscurely porrect apex; *anthers* 0.55–0.65 mm. long; *pod* loosely spreading, declined, or (when humistrate) ascending, sessile on the slightly elevated receptacle, subsymmetrically ellipsoid or ovoid-ellipsoid, bladdery inflated, 2.5–4 cm. long, 1.3–1.7 cm. (or when pressed seemingly up to 2.2 cm.) in diameter, broadly obconic or rounded at base, contracted distally into a very short and obscure, deltoid, laterally flattened beak, otherwise a trifle obcompressed, shallowly sulcate ventrally, the thin, pale green but purple-cheeked, glabrous or strigulose valves becoming stramineous, lustrous, semitransparent, delicately cross-reticulate, the funicular flange 1–2 mm. wide; *ovules* (27) 30–39; *seeds* brown, smooth but dull, 2.4–3.1 mm. long.—Collections: 9 (i); representative: *Christ* 15,539, 17,752 (NY), 17,767 (ID); *C. L. Hitchcock* 15,694 (RSA); *Ripley & Barneby* 8836 (CAS, IDS, RSA, WTU).

Washes in gullied clay bluffs, steep eroded banks in canyons, and sand or gravel bars along streams, on shale, clay, or alluvial debris, sometimes in sagebrush, infrequent but locally plentiful along the upper Salmon River, from near Challis upstream about fifty miles, and (perhaps disjunctly) along the lower Lemhi River between Baker and Leadore, in Custer and Lemhi Counties, Idaho.—Map No. 119.—Late May to July.

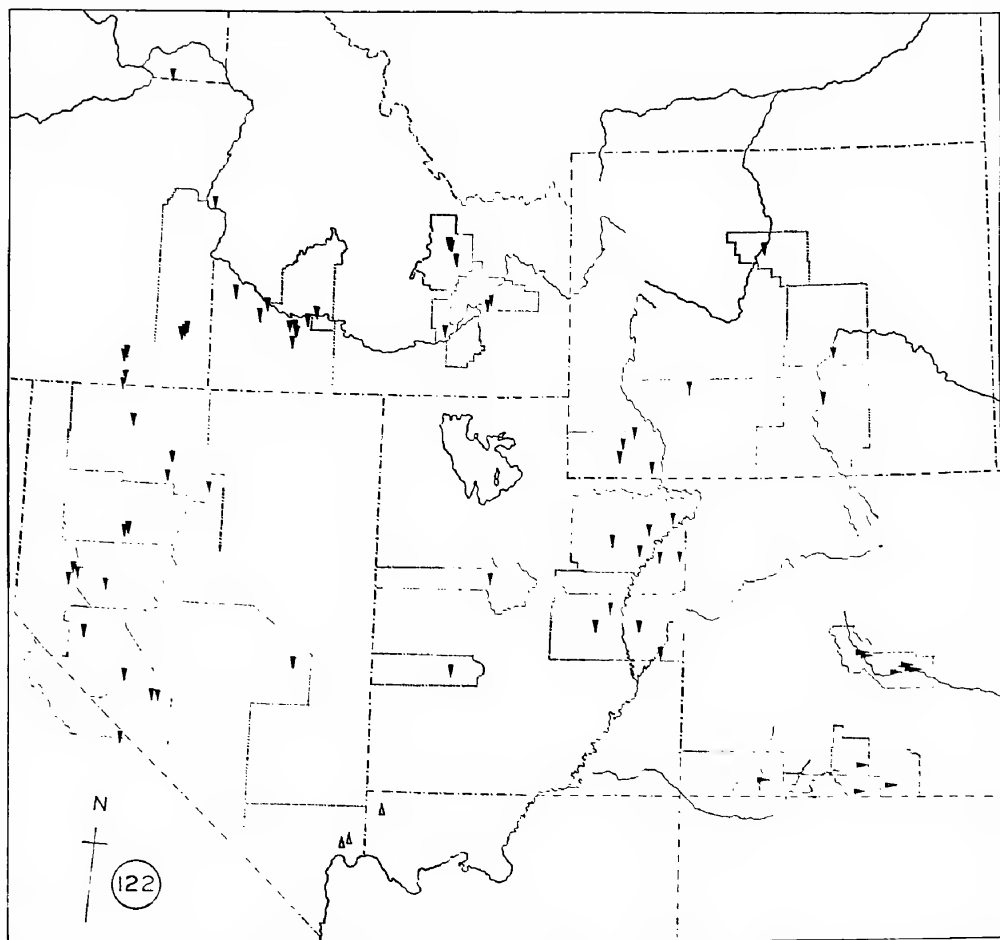
ASTRAGALUS AQUILONIUS (Barneby), stat. nov., based on *A. Wootoni* var. *aquiloni* (northern, the species isolated far n. of near relatives) Barneby in Amer. Midl. Nat. 41: 499. 1949.—“IDAHO: four miles south of Lemhi, Lemhi Co., *Hitchcock & Muhlick* No. 9218.”—Holotypus, WTU! isotypi, PH, RSA, WS!

The Lemhi milk-vetch, *A. aquilonius*, is the only species with bladdery, unilocular fruits known to occur within the watershed of the upper Salmon River. It is likely to be confused only with some member of sect. *Platytropes*, native to the same region, in which the greatly swollen pod is similar in exterior form but divided into two chambers by a broad septum. The species is closely related and technically similar to *A. Wootoni*, but at least when fully developed is a coarser, more amply leafy plant, with appreciably larger flowers (the banner 9.5–11 rather than 4.5–7.5 mm. long). Furthermore, the ovules are nearly twice as many (14–20 as opposed to 6–10 pairs) even though the average pod is only slightly larger. Vigorous individuals of *A. aquilonius* are likely to recall some forms of *A. Douglasii*, a reliably perennial species of cismontane California. However, the flowers of the two are not closely similar in fine detail of the petal-shape and -curvature, and the ordinarily 15–30-flowered raceme of *A. Douglasii* and its ovules, almost always in excess of 50, suffice to distinguish them. The Lemhi milk-vetch belongs to the group of species centering about *A. Wootoni* and *A. allochrous*, and represents the endemic austral element in the flora of the upper Salmon River canyon. Its range is separated from that of *A. Wootoni* by a distance of over 600 miles north and south.

The history of *A. aquilonius* goes back to the year 1915, when Jones discovered it near Baker on the Lemhi River. Jones referred (1923, p. 105) his autumnal specimens, which are depauperate, densely villousulous, and in advanced fruit, to an inclusive *A. triflorus* (= our *A. Wootoni* in great part), but the record was overlooked by Rydberg. The material from Baker has thinly pubescent pods, but plants with glabrous ovaries and fruits, not otherwise different, have been encountered more commonly since.

274. *ASTRAGALUS CERUSSATUS*

Low, slender, diffuse, with a short-lived perennial taproot but flowering the first season and then appearing annual, thinly villosulous throughout with fine spreading or ascending, nearly straight or crisply sinuous hairs up to 0.5–0.8 mm. long, the stems and herbage green or in youth subcinereous, the leaflets sometimes glabrescent above; *stems* several, ascending or decumbent with ascending tips, 0.3–2.5 dm. long, in older plants becoming somewhat indurated at base but scarcely caudiciform, branched or bearing short spurs at most of the axils, together forming densely leafy tufts or loose, low clumps; *stipules* thinly herbaceous, deltoid or lanceolate, 2–4 mm. long, semiamplexicaul, free; *leaves* 2.5–8 cm. long, shortly petioled, with subfiliform rachis and 13–21 narrowly oblanceolate to oblong-oblanceolate, retuse or sometimes obtuse, thin, flat leaflets 4–13 (18) mm. long; *peduncles* very slender, incurved-ascending, 2–4.5 cm. long, or some arising late in the season from axillary spurs only 1 cm. long or even less; *racemes* loosely (1) 3–7-flowered, the flowers at first ascending, declined in age, the axis 0.5–3.5 cm. long in fruit; *bracts* submembranous, ovate- or lance-acuminate, 1.5–2.5 mm. long; *pedicels* slender, at anthesis 1–1.2 mm., in fruit arcuate and 1.8–2.5 mm. long; *bracteoles* 0–2, minute when present; *calyx* 3.4–4.2 mm. long, villosulous like the herbage with white hairs, the disc about 0.5 mm. deep, the



Map No. 122. Southern Rocky Mountain and intermountain United States. Range of *A. Geyeri*: $\blacktriangledown$ var. *Geyeri*; $\triangle$ var. *triquetrus*; and of $\blacklozenge$ *A. cerussatus*.

campanulate or obconic-campanulate tube 1.7–2 mm. long, $\pm$ 1.6 mm. in diameter, the narrowly lance-subulate teeth 1.4–2.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* pale lilac, or whitish with lilac tips and pale purple veins in the banner; *banner* recurved through nearly 90°, ovate-cuneate, 5.2–6 mm. long, 3.2–4.2 mm. wide; *wings* 4.7–5.6 mm. long, the claws 1.8–2.3 mm., the lunately lance-oblong, obtuse blades 3.4–3.9 mm. long, 1.1–1.7 mm. wide; *keel* 3.6–4.3 mm. long, the claws 1.7–2.2 mm., the broadly half-obovate blades 2–2.5 mm. long, 2–2.5 mm. wide, abruptly incurved through 120° to the obliquely deltoid, obscurely porrect apex; *anthers* 0.3–0.4 mm. long; *pod* spreading or declined, sessile, readily deciduous, obliquely ovoid or ovoid-ellipsoid, bladdery-inflated, 1–2.2 cm. long, 5–14 mm. in diameter, rounded or broadly obconic at base, contracted distally into a shortly deltoid, laterally flattened beak, otherwise a trifle obcompressed, shallowly sulcate ventrally, the filiform dorsal suture more strongly convex than the ventral one, the thin, greenish or sometimes purplish valves thinly strigose-villosulous with incumbent or curly hairs 0.3–0.5 mm. long, becoming papery-membranous, stramineous, delicately reticulate, inflexed as a very narrow partial septum 0.1–0.4 mm. wide, the funicular flange $\pm$ 0.5 mm. wide; *dehiscence* apical, after falling; *ovules* 18–22; *seeds* olivaceous-brown, sometimes purple-speckled, smooth but dull, 1.9–2.5 mm. long.—Collections: 17 (iii); representative: *Osterhout* 2735 (NY, RM, WIS); *Jones* 765 (NY, P, POM); *Brandeggee* (approximate topotypi) in 1872, '3 & '4 (NY); *Ripley & Barneby* 10,171, 10,347 (CAS, NY, RSA); *Penland* 3461 (RM).

Dry sandy banks and hillsides, and sandbars and shingle bars along rivers and torrents, 5400–8300 feet, rather local but forming colonies, known only from southern Colorado: along the Arkansas River from Cañon City upstream to Poncha Springs and Salida, Fremont and Chaffee Counties; on the upper Rio Grande and Conejos River in Costilla and Conejos Counties; and on the La Plata River near Durango, La Plata County; reported (Rydberg, 1929, p. 352) from northern New Mexico.—Map No. 122.—April to August.

ASTRAGALUS CERUSSATUS (blanched, as though painted with white lead) Sheld. in Minn. Bot. Stud. 1: 139. 1894.—“Collected on the mountain sides near Cañon City, Fremont County, Colorado, by J. E. Bodin, June and July, 1890; also near Royal Gorge, Colorado, by Miss Alice Eastwood, June, 1891.”—Holotypus, *Bodin, June 11, 1890, MINN!*—*Phaca cerussata* (Sheld.) Rydb. in Bull. Torr. Club 32: 665. 1905. *Astragalus triflorus* var. *cerussatus* (Sheld.) Jones, Rev. Astrag. Pl. 11. 1923, nomen (the author's intention quite otherwise; cf. op. cit. p. 105).

The powdered milk-vetch, *A. cerussatus*, is a pretty but inconspicuous astragalus, with diffuse stems, tiny, milky-lilac flowers, and swollen fruits of notably delicate texture. It is found most commonly on gravel bars or sandbars along the flood plain of the Arkansas River or in the beds of torrents lateral to the main stream, and in these situations the older plants must be subject to flooding in the spring thaws. The average plant of *A. cerussatus* is of rapid growth and short duration, coming into flower two or three months after germination of the seed and fruiting soon after. Some colonies seem to be composed entirely of annuals. Elsewhere, however, individuals may be found with flowering stems arising from a base already indurated and caudiciform in early spring, and these are doubtless in their second or third season.

The diagnostic features of *A. cerussatus*, which resembles in most respects several of the few-flowered, annual or short-lived *Inflati*, are the loosely ascending or spreading vesture of often sinuous hairs and the bladdery pod of thinly papery texture and oblique profile which is provided with a definite even though very narrow (and easily overlooked) septum. Closely related to *A. Wootoni*, it is difficult to distinguish in theory from all forms of that widely dispersed and polymorphic species. However, the phases of *A. Wootoni* known from northern New Mexico, where forms intergradient with *A. cerussatus* are logically to be expected, are thinly strigulose with appressed hairs and have larger, subsymmetrically ellipsoid, almost beakless pods of comparatively firm texture. It is only in the lower Rio Grande Valley in New Mexico, in trans-Pecos Texas, and adjoining Mexico that forms of *A. Wootoni* technically similar to *A. cerussatus* in their small pods and villosulous vesture are known to occur, and these have slightly but significantly shorter calyx-tube and keel-petals, and truly unilocular

Pods. Jones (1923, p. 104) listed *A. cerussatus* as a synonym of his unreasonably comprehensive "*A. triflorus*," believing it to be identical with *Phaca triflora* Kunth, our *A. Wootoni* var. *Candollianus*. However there can be no question that *A. cerussatus* and its central Mexican relative exist as discrete entities. The powdered milk-vetch is maintained at the rank of species for reasons expressed in the foreword to sect. *Inflati*.

275. ASTRAGALUS ENDOPTERUS

Slender, annual or perhaps biennial, with a taproot, strigulose with fine, straight, appressed or subappressed hairs up to 0.45–0.55 mm. long, the stems and young leaves cinereous, the leaflets somewhat bicolored, brighter green and medially glabrescent above; *stems* few, erect and incurved-ascending, up to 2 dm. long, freely branching from the base upward, the branches or spurs of the second and third order often paired with a leafless peduncle, together forming leafy and floriferous plants of rounded, bushy outline; *stipules* submembranous, 1–2.5 mm. long, the lowest early becoming papery, broader than long, embracing $\pm \frac{3}{4}$ the stem's circumference, the remainder narrower, with deltoid or triangular, mostly erect blades; *leaves* 4.5–8.5 cm. long, with short, slender petioles and 7–11 distant, lanceolate, oblong, or narrowly oblong-elliptic, obtuse or truncate leaflets 8–16 mm. long, the terminal one often longer than the last pair; *peduncles* subfiliform, ascending or incurved, 1.5–2 cm. long, arising from nearly all but the lowest leaf-axils; *racemes* very loosely 4–7-flowered, the flowers declined in age, the axis 1.5–3 cm. long in fruit; *bracts* membranous, lance-ovate, ± 1.5 mm. long; *pedicels* at anthesis ascending, ± 1 mm. long, becoming arched outward, thickened, 1.5–2 mm. long in fruit; *bracteoles* 0; *calyx* ± 4 mm. long, strigulose with white hairs, the subsymmetric disc 0.6–0.7 mm. deep, the tube 2.1–2.3 mm. long, 1.7–1.8 mm. in diameter, the subulate teeth 1.8–2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish faintly pink-lined; *banner* recurved through $\pm 80^\circ$, rhombic-oval, shallowly notched, 6–6.3 mm. long, 3.8–4 mm. wide; *wings* 5.8–6 mm. long, the claws 2–2.2 mm., the obliquely obovate, obtuse blades 4.1–4.3 mm. long, 1.8–2 mm. wide, both incurved but the left one more strongly so and its inner margin infolded; *keel* 4.3–4.4 mm. long, the claws 2 mm., the broadly half-obovate blades 2.7 mm. long, 1.5–1.6 mm. wide, incurved through 100° to the bluntly deltoid, obscurely porrect apex; *anthers* 0.35–0.45 mm. long; *pod* loosely spreading or declined, sessile on the slightly elevated receptacle, subsymmetrically ovoid or ovoid-ellipsoid, bladdery inflated, 2–2.7 cm. long, 1.1–1.5 (or when pressed seemingly up to 1.7) cm. in diameter, rounded or cuneately obconic at base, contracted distally into a short, deltoid or deltoid-acuminate, laterally compressed beak, otherwise a trifle obcompressed, shallowly sulcate ventrally, the thin, pale green and faintly brown-mottled, finely strigulose valves becoming stramineous, lustrous, delicately reticulate, the funicular flange very broad, 3–3.5 mm. wide; *ovules* 28–30; *seeds* not seen.—Collections: 3 (i); representative: *L. F. Ward* in 1901 (NY, US); *Jones* (from Willow Spring) in 1890 (POM).

Gravelly washes and sandbars of summer-dry streams, ± 3700 –4000 feet, rare and local, known only from the lower Little Colorado River (Cameron; below Tanner's Crossing) and Moenkopi Wash (Willow Spring) in Coconino County, Arizona.—Map No. 121.—May and June.

ASTRAGALUS ENDOPTERUS (Barneby), stat. nov., based on *A. Wootoni* var. *endopterus* (inwardly winged, of the funicular flange within the pod) Barneby in Amer. Midl. Nat. 41: 498. 1948.—"ARIZONA: sandy bed of the Little Colorado River, at Cameron, Coconino Co., ... 5 June 1947, Ripley & Barneby 8491."—Holotypus, CAS! isotypus, RSA!

The sandbar milk-vetch, *A. endopterus*, resembles its common relative *A. Wootoni* in most details of the flowers and fruits, but differs in its repeatedly branching stems, its few, rather

distant leaflets, and the much more numerous (28–30 as opposed to 10–21) ovules and seeds. The funicular flange within the pod, to which the specific epithet refers, is also exceptionally broad. In its few leaflets, of which the terminal one is commonly longest, and in the habit of producing the first racemes at axils well below the middle of the stems, *A. endopterus* recalls *A. Geyeri*, the fruit of which is, however, smaller, greatly oblique in profile, and few-ovulate. Although poorly known and probably very local, *A. endopterus* seems to possess sufficient characters to ensure its recognition as an independent species.

276. *ASTRAGALUS SERPENS*

Low, dwarf, diffuse or tufted, with a woody taproot and closely forking, indurated caudex, the stems strigulose and the herbage strigose-pilosulous with ascending or incumbent, nearly straight or sinuous hairs up to 0.3–0.5 mm. long, the leaves cinereous, the leaflets medially glabrescent above; *stems* many, procumbent and incurved-ascending, 2.5–15 cm. long, simple or few-branched below, zigzag distally, commonly purple-tinged; *stipules* 1.5–3.5 mm. long, the lowest ovate, becoming papery, the upper deltoid or lance-acuminate, subherbaceous, embracing half to nearly the whole stem's circumference, free; *leaves* 1.5–4.5 cm. long, all petioled, with (7) 11–15 oblanceolate to obovate-elliptic, obtuse or emarginate, folded, usually crowded leaflets 2–8 mm. long; *peduncles* 7–15 mm. long, incurved-ascending, much shorter than the leaf; *racemes* loosely but very shortly 3–9-flowered, the flowers spreading at anthesis and then declined, the axis less than 1 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–1.5 mm. long; *pedicels* at anthesis 1–1.3 mm. long, in fruit arched or twisted, a little thickened, up to 1.8 mm. long; *bracteoles* 0; *calyx* 4.3–5 mm. long, densely white- or partly black-strigulose, the subsymmetric disc 0.7–1 mm. deep, the membranous, purplish, campanulate tube 2.8–3.5 mm. long, 2.2–2.6 mm. in diameter, the broadly subulate teeth 1.5–2 mm. long; *petals* dull greenish-purple, the banner with darker purple veins; *banner* abruptly recurved through ± 90 – 100° , broadly ovate-cuneate, 6.6–8 mm. long, 5.4–5.8 mm. wide; *wings* 7.5–8.5 mm. long, the claws 2.7–3.5 mm., the lunately obovate-oblanceolate, obtuse blades 4.8–5.6 mm. long, 2.1–2.8 mm. wide; *keel* 6.6–7.2 mm. long, the claws 2.7–3.5 mm., the blades 3.9–4.3 mm. long, 2–2.4 mm. wide, abruptly incurved through $\pm 100^\circ$ to the narrowly triangular, sometimes subporrect apex; *anthers* 0.45 mm. long; *pod* spreading, declined, or (when humistrate) apparently ascending, sessile but elevated on a stout, stipelike gynophore 0.7–1.5 mm. long, the subsymmetrically ovoid or ovoid-ellipsoid, bladdery-inflated body 1.3–2.5 cm. long, 7–12 (or when pressed seemingly 9–15) mm. in diameter, rounded at base, contracted distally into a short, obscure, compressed-conic beak, otherwise subterete but shallowly sulcate ventrally, the thin, brightly red-mottled, sparsely strigulose valves becoming papery, finely cross-reticulate, not inflexed, the funicular flange broad, 1.2–1.5 mm. wide; *dehiscence* apical, after falling; *seeds* brown, minutely punctate, dull, 1.7–2.5 mm. long.—Collections: 3 (i); representative: *Ripley & Barneby* 8602 (CAS, NY, RM, RSA, UTC); *R. K. Gierisch* 24 (UTC).

Open gravelly ridges, about 7500–8900 feet, forming small, scattered colonies among low sagebrush, apparently calcifuge, rare and local, known only from the mountains of central Utah (Loa Pass, Wayne County; reported from Mt. Belknap, Sevier County).—Map No. 121.—Late May to July.

ASTRAGALUS SERPENS (creeping, an inappropriate epithet) Jones in Proc. Calif. Acad. Sci. II, 5: 641. 1895.—“No. 5639i. July 17, 1894, Loa Pass, Utah, 7500° alt., in gravel, among sagebrush.”—Holotypus, POM! isotypi, NY, US!—*Phaca serpens* (Jones) Rydb. in Bull. Torr. Club 40: 47. 1913.

The plateau milk-vetch, *A. serpens*, is a dwarf and neatly pretty astragalus, chiefly notable for its triangular keel-tip and subsymmetrically bladdery, obscurely beaked, brightly mottled pod elevated out of the calyx on a short, stipelike gynophore. The general aspect of the

flowering plant is that of a dwarf *A. pubentissimus*; I can think of no nearer or more likely relative. The species was assigned by Rydberg (1929, p. 349) to a monotypic section *Serpentes* in *Phaca* subgen. *Chartocystis*, supposedly differing from the *Candolleanae* (*A. Wootoni* and near relatives) in its more soundly perennial root. It would have been more logical to refer it to subgen. *Podocystis*, for the stipelike gynophore is precisely analogous to the so-called "stipe" of *A. nutans*. Clearly, however, Rydberg's concept of *A. serpens*, and consequently of the section *Serpentes*, was highly colored by (perhaps largely based on) his own misidentified collection of *A. Perianus*, a species superficially similar because of its dwarf stature and swollen fruit, but differing in the truly sessile pod, subterranean root-crown, and connate stipules.

The species is known specifically only from the type-locality in Loa Pass, where it is locally abundant. Jones (1923, p. 108) reported it from Mt. Belknap, but I was unable to find corresponding specimens in his herbarium. His record of the plateau milk-vetch from the Elk Mountains in San Juan County has been traced back to fragmentary flowering plants of *A. sesquiflorus*, collected in Hammond Canyon by Rydberg & Garrett. The Gierisch collection cited above is very characteristic of *A. serpens* but is labeled simply "s.-w. Utah."

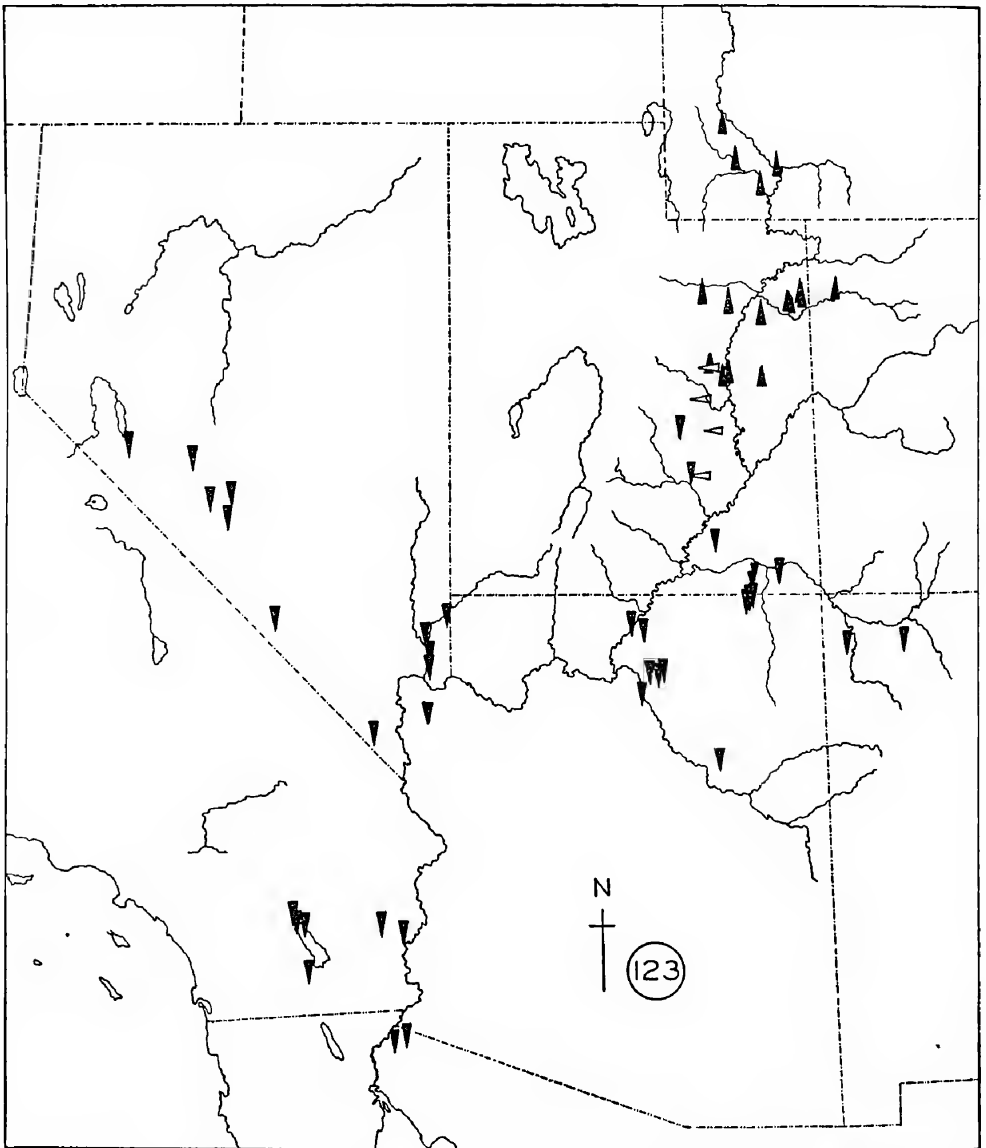
277. ASTRAGALUS PUBENTISSIMUS

Low, diffuse or loosely tufted, caulescent, biennial or perennial of short duration, often flowering the first season, with a taproot and ultimately indurated base but no true caudex, the stems strigulose with short, subappressed hairs, the herbage villousulous with fine, straight and spreading or sinuous and incumbent hairs up to 0.6–1 mm. long, greenish-cinereous or canescent, the leaflets sometimes glabrescent above; *stems* 3–many, decumbent and ascending, 2.5–25 cm. long, commonly purplish toward the base and branching at the lower nodes, densely leafy and flexuous or zigzag distally; *stipules* 1–4.5 mm. long, semi- or the lowest fully amplexicaul but not connate, deltoid or deltoid-acuminate, the lowest early becoming papery, the uppermost herbaceous, commonly reddish; *leaves* 2–8 cm. long, all petioled, with (5) 7–15 oblong-elliptic, ovate, linear-elliptic, or obovate, obtuse, retuse, obtuse and mucronulate, or rarely subacute, usually folded and crowded leaflets (2) 3–14 mm. long; *peduncles* (1) 1.5–3.5 cm. long, incurved in age; *racemes* rather densely 3–12-flowered, the flowers spreading at anthesis and declined thereafter, the axis not greatly elongating, 0.4–2.5 (3.5) cm. long in fruit; *bracts* membranous or soon becoming so, lanceolate or linear-lanceolate, (1) 1.5–3 mm. long; *pedicels* at anthesis 0.5–1.4 mm. long, in fruit arched outward, a little thickened, 1–2 mm. long, persistent; *bracteoles* 0; *calyx* 5.4–6.2 mm. long, villousulous (strigulose) with white and rarely a few black hairs (0.3) 0.4–1 mm. long, the oblique disc 0.4–1 mm. deep, the obliquely campanulate, reddish tube 2.8–4.1 mm. long, 2.3–2.9 mm. in diameter, the subulate or subulate-setaceous teeth 1.8–2.8 mm. long; *petals* pink-purple, the banner striate; *banner* recurved through 50–90°, ovate-, oval-, or obovate-cuneate, 8.8–11.7 mm. long, 5.5–8 mm. wide; *wings* 8.7–10.9 mm. long, the claws 3.1–4.3 mm., the lunately oblanceolate or narrowly obovate, obtuse or emarginate blades 5.9–8.1 mm. long, 2–2.8 (3.1) mm. wide; *keel* 7.3–8.7 mm. long, the claws 3–4.1 mm., the lunately half-obovate blades 4–5 mm. long, 2.2–2.7 mm. wide, incurved through 90–110° to the bluntly triangular or deltoid apex; *anthers* (0.35) 0.4–0.7 mm. long; *pod* spreading or declined, sessile, very obliquely lance-ellipsoid, 1.2–2 cm. long, 4–8 mm. in diameter, rounded or broadly cuneate at base, contracted distally into a short, deltoid or deltoid-acuminate beak, the body strongly turgid or inflated, carinate ventrally by the filiform but prominent suture, shallowly sulcate dorsally, incurved through ¼ to slightly over ½-circle, the thin, green or reddish valves becoming papery, stramineous, finely reticulate, thinly shaggy-pilose with lustrous, divergent hairs 1.2–2.2 mm. long, not inflexed; *dehiscence* apical, after falling; *ovules* (9) 11–18; *seeds* olivaceous or dark brown, smooth, dull or sublustrous, 2–2.5 mm. long.—Collections: 21 (viii); representative: *M. Ownbey* 3247 (NY, WS); *Ripley & Barneby* 7888 (CAS, RSA, UTC);

Barneby 12,703, 12,721 (CAS, NY, RSA); *Jones* (from Nine-Mile Canyon) in 1896 (CAS, NY, POM).

Gullied bluffs, stony washes, eroded clay knolls, and benches among junipers, usually in light, alkaline, alluvial soils derived from shales or sandstones, 5100–7000 feet, locally plentiful in the Green River and Uinta Basins, southwestern Wyoming, northeastern Utah, and immediately adjoining northwestern Colorado, and extending south in Utah to the base of Tavaputs Escarpment and the San Rafael Swell in Grand and northern Emery Counties.—Map No. 123.—May to early July.

ASTRAGALUS PUBENTISSIMUS (very hairy) T. & G., Fl. N. Amer. 1: 693. 1840, based on



Map No. 123. Nevada, Utah, Arizona, and parts of adjoining states. Range of ▲ *A. pubentissimus*; of ◻ *A. pardalinus*; and of ▬ *A. sabulorum*.

A. multicaulis (many-stemmed) Nutt. ex T. & G., op. cit. 335. 1838 (non *A. multicaulis* Ledeb., 1831).—"Dry sterile hills near Ham's Fork of the Colorado of the West... Nuttall."—Holotypus, labeled by Nuttall: "*Astragalus *multicaulis*. Ham's Fork of Colorado of the West." BM! isotypi, GH, NY, PH!—*Tragacantha pubentissima* (T. & G.) O. Kze., Rev. Gen. 947. 1891. *Phaca pubentissima* (T. & G.) Rydb. in Bull. Torr. Club 40: 48. 1913.

Astragalus Peabodianus (George Foster Peabody, 1852–1938, banker and philanthropist) Jones in Zoö 3: 295. 1893.—"... at 5,000 feet altitude, Thompson's Springs, Eastern Utah, May 7, 1891."—Holotypus, POM (2 sheets)!

The Green River milk-vetch, *A. pubentissimus*, is distinguished among the short-lived *Inflati* by its comparatively little swollen, lunately incurved pod of papery texture beset with exceptionally long and lustrous hairs. In the Green River and Uinta Basins it is the only astragalus of its type other than the thinly strigulose *A. Geyeri* (differing further in its tiny, whitish flowers) and is therefore easily recognized even at early anthesis. South of Tavaputs Escarpment, however, the range of *A. pubentissimus* overlaps or abuts on those of *A. sabulonum* and *A. pardalinus*, and without ripe or at least fully formed fruits these three closely related and habitually similar species are difficult to tell apart. The smaller flowers, shorter calyx-tubes, and ordinarily narrower and sharper keel-tips are decisive differential characters both of *A. sabulonum* and of *A. pardalinus*, but they require close observation and careful measurement. The high ovule-number (20–28 rather than 10–18) distinguishes *A. pardalinus* from both its relatives.

The range of *A. pubentissimus* probably extends farther north than is shown on the distribution map, but I have no precise locality outside the Green River Valley. The species was encountered by the Northwest Wyoming Expedition in 1873 (Parry 76, NY, PH), possibly in the Wind River Valley, and is to be expected in the Big Horn Basin. On the lower White River near Rangely, Colorado, *A. pubentissimus* has fallen under suspicion as a stock poison (Brown & Jensen in 1958, NY).

278. ASTRAGALUS PARDALINUS

Annual or perennial of short duration, closely resembling *A. sabulonum*, *A. pubentissimus*, and *A. Wootoni* var. *Candollianus* in habit of growth, strigulose-villosulous throughout with spreading and incurved-ascending, partly sinuous, or mostly nearly straight and subappressed hairs up to 0.6–0.9 (1) mm. long, the herbage cinereous or when young canescent, the leaflets pubescent on both sides but bicolored, yellowish-green beneath the vesture on the upper side; stems in slender plants of the first season 1–3, in more robust or older ones several and freely branching from base to middle, (3) 5–27 (35) cm. long, at length becoming indurated at base but hardly caudiciform; stipules 2–5 mm. long, deltoid or triangular, the lowest early becoming papery, sometimes broader than long, fully or almost fully amplexicaul, sometimes united by a low membranous collar or by a stipular line, the upper ones subherbaceous, broadly triangular, semi-amplexicaul; leaves 3–6.5 cm. long, all petioled, with 11–17 oblong-oblancheolate or (in some lower leaves) obovate-cuneate, truncate-emarginate, shallowly retuse, or mucronulate and acute, flat or loosely folded leaflets 4–20 mm. long; peduncles slender, incurved, (1) 2–4 cm. long; racemes loosely but shortly 3–8-flowered, the flowers weakly ascending or spreading, the axis becoming 1–3.5 cm. long in fruit; bracts submembranous, pallid or purplish, lanceolate, 1–3.5 mm. long; pedicels at anthesis ascending, 0.8–2 mm. long, in fruit a little thickened, divaricate or recurved, 1.5–3.6 mm. long; bracteoles 0–2, minute when present; calyx 4.8–6.6 mm. long, villosulous with white or partly black hairs, the subsymmetric disc 0.5–0.8 mm. deep, the broadly campanulate, green or purplish tube 2.3–2.8 mm. long, 2.3–2.8 mm. in diameter, the slenderly subulate-setaceous teeth 2.3–2.8 mm. long; petals pinkish- or (reportedly) dark purple, the color fleeting; banner abruptly recurved through 60–90°, broadly ovate- or obovate-cuneate, or flabellate, openly notched, 6.3–8.2 mm. long, 4.5–7 mm. wide; wings 5.7–7.9 mm. long, the claws 2.1–3.2 mm., the obliquely oblong-obovate, subtruncate or obscurely emarginate blades 4.2–5.4 mm. long, 2.2–2.6 mm. wide; keel 5.8–6.8

mm. long, the claws 2.2–3 mm., the half-triangular-obovate blades 3.6–4.1 mm. long, 2–2.6 mm. wide, abruptly incurved through 95–100° to the bluntly or sharply triangular, often porrect apex; *anthers* 0.35–0.45 (0.5) mm. long; *pod* declined (sometimes humistrate), sessile on the slightly elevated receptacle, obliquely ovoid-ellipsoid, inflated but not strongly bladdery, 1.3–2.1 cm. long, 8–11 mm. in diameter, rounded at base, contracted distally into a deltoid or narrowly triangular-subulate, laterally flattened beak 1.5–3 mm. long, otherwise gently obcompressed, openly and shallowly sulcate ventrally along the straight or low-convex suture, convex dorsally, the thinly fleshy, green, often brightly purple- or red-mottled valves becoming papery, cross-reticulate, villousulous with spreading-incurved or loosely ascending, at least partly contorted hairs up to 0.6–0.8 mm. long, not inflexed, the funicular flange obscure, 0.1–0.6 mm. wide; *dehiscence* apical, after falling; *ovules* 20–28; *seeds* not seen ripe.—Collections: 4 (i); representative: *Jones* (San Rafael Swell, May 17) in 1914 (POM); *B. F. Harrison* 11,224 (BRY, RSA, UC, US); *Barneby* 13,147 (BRY, CAS, GH, NY, RSA, US).

Sandy bluffs, plains, and dunes, sometimes with *Ephedra* and *Poliomintha*, ± 4300–5000 feet, apparently rare and local, known only from the east side of the Colorado Basin in the valleys of the Price, San Rafael, and Muddy Rivers, Emery and Wayne Counties, Utah.—Map No. 123—May and June.

ASTRAGALUS PARDALINUS (Rydb.), comb. nov., based on *Phaca pardalina* (panther-spotted, of the pod) Rydb. in N. Amer. Fl. 24: 352. 1929.—“Type collected on Cedar Mountain, Green River, Utah, May 20, 1915, *M. E. Jones* . . .”—Holotypus, NY! isotypi, DS, POM (3 sheets)!

The herbarium of The New York Botanical Garden possesses four sheets labeled *Phaca pardalina* in Rydberg's hand. One (San Rafael Swell, *Jones* in 1914) represents *A. sabulonum*. Two (Green River, *Jones* in 1914; Nine-Mile Canyon, *Jones* in 1896) are *A. pubentissimus*, readily distinguished by the long, lustrous vesture of the strongly incurved, thin-textured pod. The fourth, cited as *typus* of *P. pardalina*, is superficially similar to the foregoing, differing nevertheless in several small but taxonomically important characters, and these differences are fully borne out by study of the ample duplicate material in the *Jones* collection (POM). The three species, all of which seem to occur in close proximity in the San Rafael Swell, are easily confounded because of their overall likeness in habit and vesture. The flower of *A. pardalinus* is almost identical in size and detail of petal-shape and -proportion with *A. sabulonum*, and like it in the relatively firm texture of the pod. The fruit, however, is subsymmetrically ovoid-ellipsoid rather than very strongly or hamately incurved, and the ovules are significantly more numerous, 20–28 instead of 10–19. The larger flower, more obtuse keel-tip, and again a strongly incurved pod, of much thinner texture and long-hirsute but again relatively few-seeded, serve to distinguish *A. pubentissimus* even more sharply. The panther milk-vetch, *A. pardalinus*, was one of several *Aridi* known to *Jones* in the field and recognized as distinct forms, even though he finally referred all of them to an inclusive and unreasonably variable “*A. triflorus*.” In his Revision (1923, p. 105) *Jones* described it as a variant of *A. triflorus*, having the habit of *A. cerussatus* combined with “fine soft pubescence, beautifully mottled nearly globose pods, elongated calyx-teeth, and dark purple flowers, appearing so like *A. pubentissimus* that only examination of the pods and calyx-teeth can separate them.” *Jones* collected *A. pubentissimus* on Cedar Mountain the same day that he secured the *typus* of *P. pardalina*, and there can be no doubt whatever that he assessed them correctly as representing distinct species. The previous summer *Jones* collected *A. pardalinus* and *A. sabulonum* together (or near at hand) in the San Rafael Swell, and here again he distinguished them without difficulty. The panther milk-vetch differs from the other villousulous *Aridi*, all distantly allopatric, by various combinations of small characters which assume importance only in the context of the subsection: from *A. cerussatus* of the southern Rocky Mountains in its larger, brightly colored flowers (the keel 5.8–6.8, not 3.5–4.5 mm. long); from *A. Gilmani*, isolated in the Panamint Mountains, in the relatively numerous (13–17, not 7–13) leaflets and (20–28, not 8–12) ovules; and from *A. Wootoni* var. *Candollianus* of central Mexico in its narrower, less inflated pod of firmer texture, and ovules in 10 to 14 rather than 7 to 10 pairs.

279. *ASTRAGALUS SABULONUM*

Low, diffuse annuals, diminutive or comparatively coarse and leafy, with a

filiform or slender taproot, the stems sometimes becoming indurated at base late in the season but the root apparently never persisting into a second year, the stems and herbage villous-hirsutulous with fine, spreading, ascending, or curly and entangled hairs up to 0.5–1 mm. long, usually densely so and silky- or hoary-canescens, sometimes thinly so and greenish, the leaflets bicolored, yellowish-green beneath the vesture and often medially glabrescent above; *stems* 1–3 from the cotyledons, 1.5–26 cm. long, in small individuals solitary and simple, either erect or decumbent, when more vigorous branching from the lower nodes, the branches incurved-ascending or prostrate with ascending tips, simple and zigzag distally, usually purple-tinged; *stipules* subherbacous, often purplish, becoming brownish and papery, deltoid or deltoid-acuminate, 1.5–4 mm. long, not more than semi-amplexicaul-decurrent, the blades often squarrose; *leaves* 1.5–6.5 cm. long, all petioled, with (5) 9–15 oblanceolate, oblong, or rarely obovate-cuneate, retuse, truncate, or obtuse, flat or folded leaflets (2) 4–13 mm. long; *peduncles* incurved-ascending, 1–3 (4) cm. long; *racemes* loosely 2–5 (7)-flowered, the flowers spreading or loosely ascending at anthesis, declined thereafter, the axis a little elongating, 0.3–2.5 cm. long in fruit; *bracts* submembranous, linear-setaceous or lanceolate, 1–2.5 mm. long; *pedicels* at anthesis 0.8–1.2 mm. long, in fruit somewhat thickened, arched outward, 1.2–2 mm. long, persistent; *bracteoles* 0; *calyx* 3.3–6.2 mm. long, white- or rarely partly black-hirsutulous, the disc about 0.5 mm. deep, the tube 1.6–2.4 mm. long, (1.8) 2–2.7 mm. in diameter, the subulate, often setaceous-tipped teeth 1.7–3.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* ochroleucous tinged or veined with lilac or dull purple, more rarely violet-purple with a pale, striate eye in the banner; *banner* recurved through 50–70°, 5.2–7.2 mm. long, the shortly cuneate claw abruptly expanded into an ovate, obovate or suborbicular, obtuse or obscurely emarginate blade 3.8–5.4 mm. wide; *wings* 5.7–6.7 mm. long (sometimes a trifle longer than the banner), the claws 1.8–2.6 mm., the obliquely obovate, obtuse or subemarginate, slightly incurved blades 4.2–5.3 mm. long, 1.8–2.4 mm. wide; *keel* (5) 5.4–6.5 mm. long, the claws 2–2.6 mm., the broadly lunate blades (3) 3.2–4.2 mm. long, (1.8) 2–2.3 mm. wide, incurved through 100–120° to the rather narrowly triangular, erect or slightly porrect apex; *anthers* (0.35) 0.4–0.5 mm. long; *pod* spreading or declined (often humistrate), sessile, obliquely ovoid, oblong-ovoid, or ovoid-ellipsoid, turgid or somewhat inflated but not bladdery, 9–17 (20) mm. long, (4) 5–8 (11) mm. in diameter, either lunately incurved or sometimes abruptly hooked toward the middle, somewhat obcompressed at the cuneate or rounded base and there often sulcate ventrally, contracted distally into a short, deltoid beak, either rounded or shallowly and openly sulcate dorsally, the thinly fleshy, green or purple-cheeked, sometimes obscurely red-mottled, thinly to densely white-hirsutulous or almost hirsute valves becoming leathery or stiffly papery, brownish or stramineous, not inflexed; *dehiscence* apical, through the gaping beak, after falling; *ovules* 10–19; *seeds* brown, sometimes purple-dotted, lustrous but irregularly pitted, 2–2.5 mm. long.—Collections: 40 (x); representative: *A. & R. Nelson* 3307 (NY, SMU, WS); *Keck & al.* 6190 (NY); *Eastwood & Howell* 9471 (CAS, WS); *Ripley & Barneby* 2871, 8379 (CAS, RSA); *Holmgren* 3221 (NY, RSA, TEX, WS, WTU); *Barneby* 12,666 (CAS, NY, RSA); *MacDougal* 87 (NY).

Sandy flats, dunes, sandy or gravelly washes, and pockets in gullied clay hills, widespread and locally plentiful in the Colorado Basin and southern Great Basin, between 2000 and 6500 feet, from the lower Little Colorado River in Coconino County, Arizona, north to the San Rafael Swell, Emery County, Utah, and east up the San Juan River into northwestern San Juan County, New Mexico,

west into northern Mohave County, Arizona, and thence north through southern Nevada to southern Nye and Esmeralda Counties; also disjunctly, from 350 feet below to about 600 feet above sea level, locally plentiful in *Larrea* desert around the Salton Sea, from near Mecca and Indio in interior Riverside County, California, south through Imperial County to extreme northwestern Sonora (and probably adjoining Baja California).—Map No. 123—February to July, or in southeastern California, November to April.

ASTRAGALUS SABULONUM (of coarse sands and gravels) Gray in Proc. Amer. Acad. 13: 368. 1878.—"Southeastern border of Nevada, near the confluence of Muddy River with the Rio Virgen, on sandy ridges, Dr. Palmer, 1877."—Holotypus (from "Muddy River at St. Thomas," Palmer 110 in 1877), GH! isotypi, K, MO, NY (2 sheets) US!—*Phaca sabulorum* (Gray) Rydb. in Bull. Torr. Club 40: 47. 1913.

Astragalus virgineus (of the Virgin River) Sheld. ap. Cov. in Contrib. U. S. Nat. Herb. 4: 88. 1893.—"Type specimen in the United States National Herbarium, No. 1910, Death Valley Expedition; collected May 6, 1891, below St. George, in the Valley of the Virgin River, Lincoln County, Nevada [acc. to Cov., op. cit. p. 276, below St. Thomas, Nevada, i.e., on the lower Virgin River in the present Clark County], by Vernon Bailey."—Holotypus, US!

Phaca arenicola (dwelling in sand) Rydb. in N. Amer. Fl. 24: 356. 1929.—"Type collected in sand at Mecca, Salton Basin, Southern California, Feb. 28, 1913, Parish 8467..."—Holotypus, NY! isotypus, NY!

Phaca lerdoensis (of Colonia Lerdo) Rydb. in N. Amer. Fl. 24: 356. 1929.—Type collected at Colonia Lerdo, northern Sonora, February, 1904, D. T. Macdougal..."—Holotypus, NY!

The gravel milk-vetch, *A. sabulorum*, is quite unusual in the section because of its small, tumescent but not really inflated pod with decidedly juicy, inwardly filamentous valves drying out to a leathery or stiffly papery texture. The affinities of the species are nevertheless apparent by way of *A. pubentissimus*, geographically vicariant and often confused with *A. sabulorum*, but differing in its longer petals further exerted from the calyx and in the pod which is equally or even more strongly oblique and incurved but bladdery, papery-membranous, and shaggy-pilose with much longer, lustrous hairs. Occasional specimens of *A. sabulorum* have been misidentified as *A. desperatus*, a reliably perennial species of the Colorado Basin, which is commonly subcaulescent and bears papery pods similar to those of *A. pubentissimus* but mostly smaller and hirsute with divergent hairs seated on a minutely bulbous base.

Other notable features of *A. sabulorum* are its bicentric dispersal and enormous altitudinal tolerance. Above 2000 feet in the interior deserts, from southern Nevada east and northward, the seeds germinate in spring and the season of active growth lasts from about the end of February or April to June or early July. The greater part of the life-cycle takes place in the period of long days and short nights after the spring equinox. Near and below sea level in the Salton Basin the plants behave as winter annuals, the seed germinates in late fall or winter, and the active growth is spaced over the short days and long nights before and after the winter solstice. It is astonishing that no perceptible modification in form has accompanied the physiological adaptation to environments so substantially different; except that the plants in the Colorado Desert tend to be more robust and coarsely leafy and to become indurated at base early in the year (sometimes, as in the typus of *Phaca arenicola*, appearing biennial in consequence), I can make no distinction between the plants in the two main areas of dispersal. Along the San Juan River eastward from Monument Valley, the average plant of *A. sabulorum* is less densely and a trifle more shortly pubescent than elsewhere, but the difference in vesture is really negligible.

The type-collections of *A. sabulorum* and *A. virgineus* came from nearly the same spot and are essentially identical. That of *P. lerdoensis* was supposed to differ from *A. sabulorum* in its decumbent branches and villous vesture, features characteristic of the species. The differential characters of *P. arenicola* were a "suffruticulose," in reality only slightly indurated base, and inconsiderable differences in length of the inflorescence and shape of the leaflets. Neither has any claim to taxonomic recognition.

280. *ASTRAGALUS NUTANS*

Slender, diffuse, annual, biennial, or perhaps short-lived perennial, with a slender taproot, strigulose nearly throughout with fine, straight, appressed or subappressed hairs up to 0.25–0.6 mm. long, the herbage greenish-cinereous or the young leaves canescent, the leaflets pubescent on both sides but sometimes

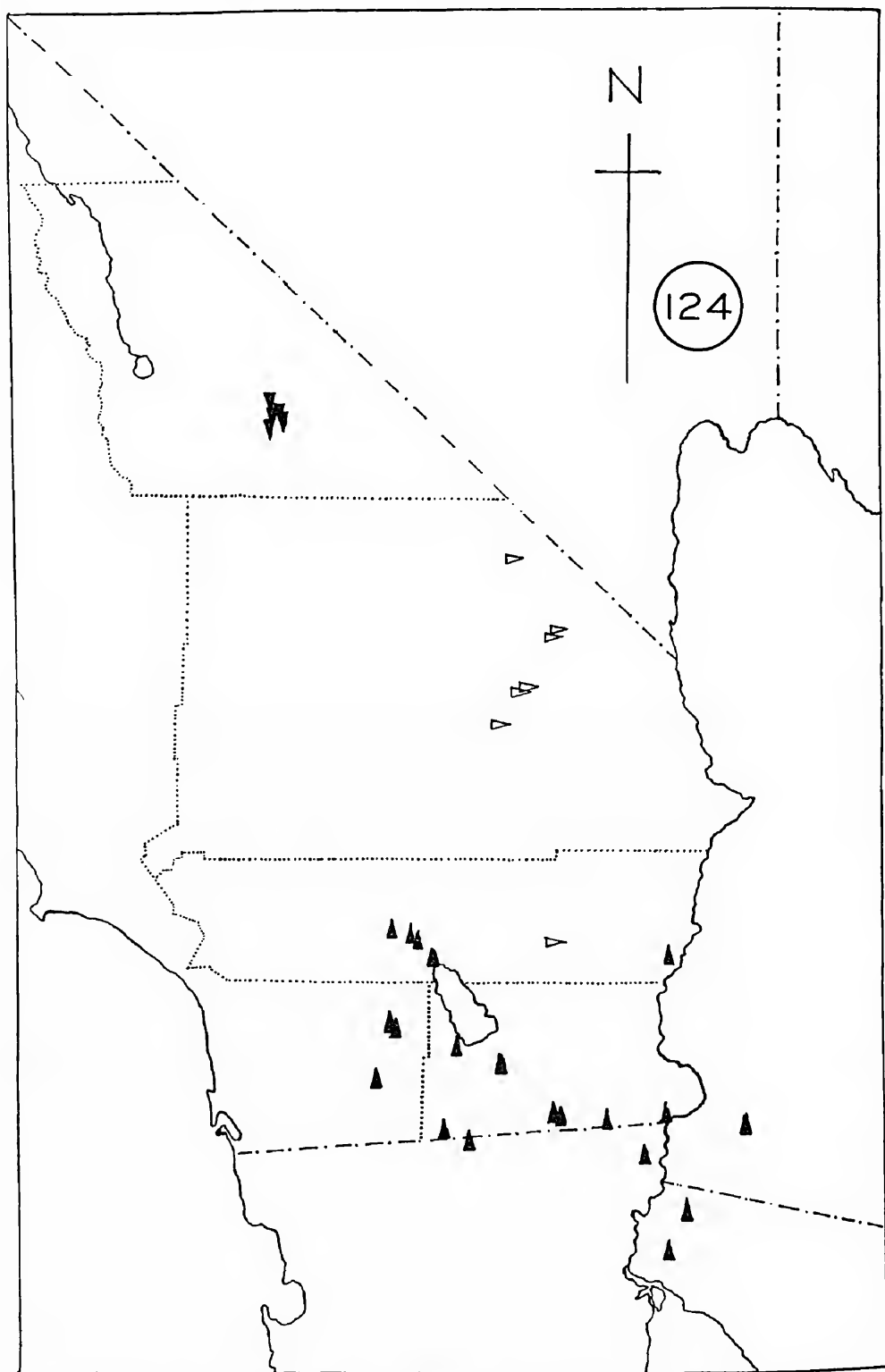
medially glabrescent above; *stems* solitary and erect in young specimens, in older plants several, prostrate and incurved-ascending, 6–15 cm. long, mostly simple, floriferous upward from near or below the middle, flexuous or zigzag distally; *stipules* 1–4 mm. long, the lowest early becoming papery, broadly deltoid, the upper ones ovate or lanceolate, about semiamplexicaul; *leaves* (2) 3–8 cm. long, slender-petioled, with 7–13 broadly or narrowly elliptic or oblanceolate, obtuse, shallowly emarginate, or (especially in some upper leaves) subacute, flat or loosely folded leaflets (3) 5–15 mm. long; *peduncles* ascending, 2–5 cm. long, shorter than the leaf; *racemes* loosely 6–10-flowered, the flowers loosely ascending or in age declined, the axis early elongating, (1) 1.5–3.5 (4) cm. long in fruit; *bracts* submembranous, narrowly ovate or triangular-lanceolate, 1–2 mm. long; *pedicels* at anthesis ascending, 1–1.4 mm. long, in fruit strongly arched outward or divaricate, thickened, 1.4–2 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4–4.6 mm. long, strigulose with black or mixed black and white hairs, the oblique disc 0.7–0.8 mm. deep, the campanulate, often purplish tube 2.5–3.2 mm. long, 2.2–2.5 mm. in diameter, the subulate teeth 1.2–2 mm. long, the whole becoming papery, ruptured or not, persistent; *petals* pink-purple drying violet, the banner with a pale, striate lozenge in the fold, the wing-tips paler or white; *banner* recurved through $\pm 90^\circ$, ovate-cuneate, emarginate, 7.8–10.4 mm. long, 5.2–6 mm. wide; *wings* 7.5–8.3 mm. long, the claws 2.8–3.4 mm., the oblong-oblanceolate or narrowly obovate, obtuse blades 5–5.9 mm. long, 2.2–2.6 mm. wide, both incurved but the left one more abruptly so and further than the right; *keel* 5.9–6.6 mm. long, the claws 2.7–3.4 mm., the half-circular or -obovate blades 3.3–3.9 mm. long, 2–2.2 mm. wide, abruptly incurved through $95\text{--}105^\circ$ to the blunt apex; *anthers* 0.4–0.5 mm. long; *pod* horizontal or declined, sessile on the conical receptacle or on a slender, stipelike gynophore up to 2 mm. long, the body plumply ovoid or broadly oblong-ellipsoid, bladdery-inflated, (1.3) 1.5–2.5 cm. long, 1.1–1.5 cm. in diameter, rounded at base, contracted distally into an erect or slightly incurved, broadly deltoid or triangular, laterally flattened beak, otherwise subterete, shallowly sulcate ventrally, the filiform sutures equally convex or the dorsal one sometimes a little more strongly so, the thin, pale green, thinly strigulose valves becoming stramineous, papery-membranous, subdiaphanous, somewhat lustrous, not inflexed, the funicular flange well-developed, 1–2.5 mm. wide; *ovules* 19–24; *seeds* brown, smooth but dull, 1.7–2.3 mm. long.—Collections: 8 (o); representative: *Munz, Johnston & Harwood 4213* (DS, NY, POM); *Munz 13,722* (DS, POM), *13,852* (POM); *Parish 10,364* (DS, POM); *Jones* (from Old Dad Mts.) in 1926 (CAS, POM, US).

Sandy flats and stony washes in the foothills of desert mountains, with *Larrea* or *Yucca brevifolia*, 1500–6400 feet, uncommon, known only from the eastern Mohave Desert (Clark, New York, Providence, and Old Dad Mountains) and extreme northern Colorado Desert (Chuckwalla Mountains), San Bernardino and Riverside Counties, California.—Map No. 124.—March to June, occasionally again in October.

ASTRAGALUS NUTANS (nodding, of the pod) Jones, Rev. Astrag. 108, Pl. 12. 1923.—“Providence Mountain eastern California... May 1902, Brandegee.”—Holotypus, collected May 26, 1902, POM! isotypi, NY (fragm.), UC-JEPS (holotypus of the following)!—*Phaca nutans* (Jones) Rydb. in N. Amer. Fl. 24: 342. 1929.

Astragalus deserticola (dwelling in the desert) Jeps., Man. Calif. 565. 1925 (“deserticolus”).—“Providence Mts. (T. Brandegee, type)”—Holotypus (an isotypus of the preceding), UC-JEPS!

Astragalus chuckwallae (of the chuckwalla, *Sauromalus ater*, an edible lizard) Abrams, Ill. Fl. Pac. St. 2: 586, fig. 2834. 1944.—“Type collected in a sandy wash, vicinity of Corn Springs, Chuckwalla Mountains, Colorado Desert, California, P. A. Munz & D. Keck 4779 (no. 155382 Dudley Herbarium).”—Holotypus, collected April 9–12, 1922, DS! isotypus, POM!



Map No. 124. Mohave and Colorado Deserts in southeastern California and adjoining Arizona and Mexico. Range of $\blacktriangle$ *A. aridus*; of $\blacktriangle$ *A. Gilmani*; and of $\triangle$ *A. nutans*.

The Chuckwalla milk-vetch, *A. nutans*, is one of three annual or short-lived perennial astragali with small, purple flowers and swollen, papery, unilocular fruits found locally on the Mohave Desert, and it is distinguished only with some difficulty from the other two. The obligately annual *A. insularis* var. *Harwoodii*, although largely of more southern distribution, extends north to the edge of the range of *A. nutans* and resembles it in growth-habit and in vestiture of straight, appressed hairs. It differs in having 11–19 rather than 7–13 leaflets to the mature leaf, in its decidedly smaller flower (the banner 5–6, not over 7.5 mm. long), and in its pod of more oblique outline as seen in profile and enclosing only 7–13 rather than 19–24 ovules. The third species, *A. Gilmani*, is found at considerably greater elevations than *A. nutans* and is apparently endemic to the Panamint Mountains. It may be recognized by the spreading-incurved pubescence of the leaves and by the comparatively few (8–12) ovules. In the number of leaflets, size of the flowers, and perennial or perennant root, *A. Gilmani* and *A. nutans* are alike; doubtless they are close allies.

Variation in development of the gynophore, from a conical boss no taller than the caly-cine disc into a slender, stipelike gynophore about equaling the tube of the calyx in length, has been the subject of an analytic note (Barneby, 1950, p. 203). It must suffice to mention here that *A. chuckwallae* with its truly sessile pod differs in no perceptible other detail from the supposedly stipitate *A. nutans*. So far as I can tell at present, the two forms do not occur in the same population, but their ranges are known to overlap.

281. ASTRAGALUS GILMANI

Low, diffuse, perennial but of short duration, commonly flowering the first season, with a slender taproot, loosely strigulose or villosulous with spreading, loosely ascending, or incurved-ascending hairs up to 0.4–0.6 mm. long, the stems and herbage greenish-cinereous, the leaflets pubescent on both sides, sometimes a little more densely above than beneath; *stems* usually several, incurved-ascending or decumbent with ascending tips, (4.5) 8–25 cm. long, simple or sparingly branched near the base, floriferous upward from near or below the middle; *stipules* 1–4 mm. long, membranous or herbaceous with membranous margins, the lowest becoming papery and brownish, ovate or triangular-acuminate, $\pm$ semiamplexicaul, thinly pubescent dorsally; *leaves* (1.5) 2–7.5 cm. long, all petioled but the uppermost sometimes shortly so, with (7) 9–13 broadly to narrowly elliptic-oblancoate, obtuse or emarginate, often purplish-margined, folded leaflets (2) 3–12 mm. long; *peduncles* incurved-ascending, (0.7) 1.5–3.5 cm. long, shorter than the leaf; *racemes* very loosely (3) 4–9-flowered, the flowers ascending, then spreading, ultimately declined, the axis (1) 1.5–3.5 (4.3) cm. long in fruit; *bracts* submembranous, triangular-lanceolate, 0.7–1.5 mm. long; *pedicels* at anthesis ascending, (1.2) 1.6–2.6 mm. long, in fruit recurved or divergent, a trifle thickened, 1.8–4.3 mm. long; *bracteoles* 0; *calyx* 3.5–5.4 mm. long, loosely strigulose or subvillosulous with mixed black and white hairs, the obconic, subsymmetric disc 0.7–1.3 mm. deep, the reddish tube 2.5–3.4 mm. long, 1.7–2.4 mm. in diameter, the subulate teeth 0.9–2.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* regularly but only slightly graduated, pink-purple drying violet, the banner striate; *banner* recurved through $\pm$ 45°, ovate- or obovate-cuneate, shallowly notched, 6.1–8 mm. long, 4–5.1 mm. wide; *wings* 5.6–7.5 mm. long, the claws 2–2.9 mm., the obovate, oblanceolate, or lunately elliptic, obtuse or erose-emarginate blades 4.1–5.1 mm. long, 1.5–2 mm. wide, both incurved but the left one further and more abruptly than the right and its inner margin infolded; *keel* 4.7–6.1 mm. long, the claws 2–2.9 mm., the half-obovate blades 3–3.5 mm. long, 1.5–2.1 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.35–0.5 mm. long; *pod* horizontal or declined, sessile on the slightly elevated receptacle or on an incipient gynophore up to 0.8 mm. long, the body obliquely ovoid-ellipsoid or -acuminate, bladderly-inflated, 1.3–2.6 cm. long, 8–15 mm. in diameter, rounded or broadly obconic at base, contracted distally into a broadly deltoid, erect or slightly incurved, laterally flattened beak 2–5.5 mm. long, otherwise terete or a trifle obcompressed, shallowly

sulcate dorsally, ventrally, or both, the thin, green or minutely purple-dotted valves strigulose with subappressed or incumbent hairs, becoming papery-membranous, stramineous, somewhat lustrous, delicately reticulate, not inflexed, the funicular flange well developed, (1) 1.2–2 mm. wide; *ovules* (8) 10–12; *seeds* brown, smooth or nearly so, dull, (2) 2.5–3.1 mm. long.—Collections: 10 (o); representative: *Munz 14,800* (CAS, POM, RSA); *Roos 2887, 2898* (RSA); *Hoffmann 478* (SBM).

Gravelly flats, brushy hillsides, and canyon slopes, 6500–10,000 feet, commonly among sagebrush in juniper-piñon woodland, local, known only from the Panamint Mountains (Wood Canyon; Wild Rose Canyon and Mahogany Flats; Telescope Peak; Death Valley and Hanaupah Canyons), Inyo County, California.—Map No. 124.—May to July, occasionally later.

ASTRAGALUS GILMANI (Marshall French Gilman, 1871–1944, for many years botanist at Death Valley National Monument) Tidest. in Proc. Biol. Soc. Wash. 50: 20. 1937.—“Type specimen . . . collected in Death Valley Canyon, Panamint Mountains, California, July 2, 1895, by M. French Gilman (No. 1861).”—Holotypus, US!

Astragalus triflorus var. *morans* (dilatory, from the delayed anthesis) Crum ex Jeps., Fl. Calif. 2: 354. 1936.—“Hanaupah Cañon, Coville & Gilman 44 (type) . . .”—Holotypus, collected September 16, 1931, at the head of Hanaupah Canyon (9350 ft.), US! isotypus (fragm.), JEPS!—*A. Wootoni* var. *morans* (Crum) Barneby in Amer. Midl. Nat. 41: 498. 1949.

In practice no difficulty should arise in identifying material of the Gilman milk-vetch, for it is apparently endemic to the Panamint Mountains and is the only *astragalus* of its type, with small, purple flowers and bladdery, unilocular pods, known to occur in the Death Valley region. In theory, however, it is difficult to separate this from some forms of the polymorphic *A. Wootoni*, the “*A. triflorus*” of early authors, to which Sheldon (1893, p. 88) referred the specimens collected by the Death Valley Expedition. Comparison of the descriptions of *A. Gilmani* and *A. Wootoni* in these pages shows that there is almost no feature of the present species which does not occur somewhere in the great range of its commoner relative. In general the stipules, bracts, and calyx-teeth of the Gilman milk-vetch are shorter than in *A. Wootoni*, the leaflets fewer, the pods on the average a little smaller, with a better-developed funicular flange within; and the ovules are also slightly fewer. These difference are comparatively slight ones, and my reduction of *A. Gilmani* to varietal rank (as *A. Wootoni* var. *morans*) can be defended logically. However, it must be remembered that the forms of *A. Wootoni* which resemble *A. Gilmani* in their villosulous vesture, purple petals, or both, are found far distant from Death Valley to the south and east, chiefly in Mexico and no nearer than in Mesilla Valley in southern New Mexico. By contrast the phase of *A. Wootoni* occurring in Mohave County, Arizona, and adjoining California is easily distinguished by its white flowers, appressed vesture, and large, relatively stiff-walled pod. The latter is distributed over sandy flats in the *Larrea* belt, at elevations below 4000 feet, an environment very different from that favored by *A. Gilmani* in the Panamints.

282. *ASTRAGALUS INSULARIS*

Slender, occasionally diminutive, diffuse, annual or winter-annual, perhaps sometimes persisting into a second season when the stems become a little indurated at base, strigulose with straight or nearly straight, appressed or subappressed hairs up to 0.4–0.7 mm. long, the herbage green or cinereous, the leaflets either equally pubescent on both sides or medially glabrescent or fully glabrous above; *stems* in seedling or depauperate plants solitary and erect, more commonly 3–several, radiating from the root-crown and incurved-ascending or prostrate, 0.4–3.5 (5.5) dm. long, simple or when vigorous branching up to the first peduncle, and the branches sometimes again branched or spurred, floriferous upward from near or often from well below the middle; *stipules* thinly herbaceous becoming papery, (1) 1.5–4 (5) mm. long, triangular, deltoid-, or triangular-acuminate, about semiamplexicaul, the blades erect, squarrose, or deflexed; *leaves* (2) 3–12 cm. long, slender-petioled but the upper ones shortly so, with (7) 11–19 (21) broadly to narrowly elliptic, narrowly oblong, or lanceolate, acute, obtuse,

or emarginate, flat or folded (and then often backwardly arched) leaflets 3–19 mm. long; *peduncles* slender, incurved-ascending or divaricate, 0.8–7 cm. long, shorter than the leaf; *racemes* loosely 3–9-flowered, the flowers early horizontal and at length declined, the axis (0.5) 1–4 (6) cm. long in fruit; *bracts* thinly herbaceous or membranous and purplish, ovate or triangular, 0.6–1.3 mm. long; *pedicels* at first ascending, early arched outward and then decurved, at anthesis 0.4–1.2 mm., in fruit a little thickened, 0.8–2.2 mm. long; *bracteoles* 0; *calyx* 3.2–4.5 mm. long, strigulose with mixed black and white hairs, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate or turbinate campanulate, commonly purplish tube 1.8–2.7 (2.9) mm. long, 1.8–2.3 mm. in diameter, the subulate teeth 1.3–2.2 (3) mm. long, the ventral pair commonly longest, the whole becoming papery, ruptured, marcescent; *petals* reddish-purple, drying violet, the banner with a pallid, striate lozenge in the fold; *banner* recurved through ± 50 – 60° , ovate-cuneate, widely notched, 5.5–7.4 mm. long, 3.9–5.3 mm. wide; *wings* 5–6.5 mm. long, the claws 1.6–2.2 mm., the obliquely obovate, oblanceolate, or narrowly oblong, obtuse, slightly incurved blades 3.5–4.7 mm. long, 1.1–2.2 mm. wide; *keel* 4.8–6 mm. long, the claws 1.8–2.4 mm., the obliquely triangular or half-obovate blades 3–3.7 mm. long, 1.6–2.1 mm. wide, abruptly incurved through 80 – 95° to the obtuse or subacute, deltoid, sometimes obscurely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* spreading or declined, sessile on the scarcely elevated receptacle, very obliquely to subsymmetrically ovoid-ellipsoid, exceptionally lance-ellipsoid, or subglobose, bladdery-inflated, strongly or obscurely beaked at apex, (0.9) 1.1–2.4 cm. long, 0.5–1.5 cm. in diameter, the thin, pale green but purple-suffused or -dotted, sparsely strigulose valves becoming papery, stramineous, subdiaphanous, somewhat lustrous, delicately cross-reticulate, not inflexed, the funicular flange 0.2–1.5 mm. wide; *ovules* 7–12 (14); *seeds* brown or ochraceous, rarely pinkish-brown, pitted and wrinkled, dull, 2.3–3.8 mm. long.

The Cedros milk-vetch, *A. insularis*, is widely dispersed over the Colorado Desert and peninsular Baja California, where its full range is probably still only to be guessed at; it is evidently in process of evolutionary fragmentation. The segments of the species described below as varieties are all about equally variable in stature, presenting, according to the season or accident of habitat, diminutive and fleeting annual forms as well as comparatively vigorous, freely branching, and leafy individuals which sometimes persist into a second year. They differ from one another in characters of fruit-shape, indumentum, and outline of the leaflets.

Key to the Varieties of *A. insularis*

1. Pod obliquely ovoid-acuminate, contracted distally into a well-defined deltoid or triangular-acuminate beak 2.5–7 mm. long; *ventral suture* commonly prominent, much less strongly convex than the dorsal one; widespread, but along the Pacific Coast of Baja California unknown from n. of lat. 29° N. (2)
2. Plants thinly strigulose, the herbage full, deep green, the acute-mucronulate leaflets glabrous above and bearing only a few scattered hairs along the midrib and toward the margins beneath; Cedros Island and adjacent mainland, Baja California 282a. var. *insularis*
2. Plants strigulose throughout or nearly so, the herbage cinereous, the nearly always obtuse or emarginate leaflets equally pubescent on both sides or sometimes medially glabrescent above; Colorado Desert, s.-e. California and adjoining Sonora and Arizona, s. to San Lorenzo Island in the Gulf of California at lat. 28° $40'$ N. 282b. var. *Harwoodii*
1. Pod subsymmetrically ovoid or subglobose, obscurely beaked, the broadly deltoid beak at most 2.5 mm. long; *ventral suture* depressed, about equally convex with the dorsal one; local about San Quintín Bay and s. to the edge of the Vizcaino Desert, about lat. 30° – $30^\circ 30'$ N. 282c. var. *quentinus*

282a. ASTRAGALUS INSULARIS var. INSULARIS

Stems (0.3) 0.7–3 dm. long; *leaflets* rather distant, (7) 11–15 (17); *pod* 1–2.4 cm. long, 5–14 mm. in diameter, broadly turbinate at base, contracted into

an erect or slightly incurved beak 2.5–4 mm. long, the ventral suture straight or nearly so, the dorsal one gibbous-convex, the funicular flange about 0.2–0.4 mm. wide.—Collections: 12 (o); representative: *Palmer 685* (ND, NY, UC); *Anthony 303* (ARIZ, DS, NY, POM, UC); *J. N. Rose 16,151, 16,195, 16,904* (NY); *Gentry 7576* (ARIZ, DS).

Washes, canyon beds, and dry sandy plains, sometimes in temporarily moist soil of ephemeral watercourses, 5–880 feet, apparently common locally on Cedros Island and on the mainland about San Bartolomé Bay, southern district of Baja California.—Map No. 116.—February to June.

ASTRAGALUS INSULARIS (of Cedros Island) Kell. in Bull. Calif. Acad. Sci. 1: 6. 1884.—“Cedros Island . . . collected by D. J. A. Veatch.”—Holotypus, collected June 4, 1877, CAS! —*A. triflorus* var. *insularis* (Kell.) Jones in Proc. Calif. Acad. Sci. II, 5: 637. 1895. *Phaca insularis* (Kell.) Rydb. in N. Amer. Fl. 24: 353. 1929.

Astragalus Pondii (Charles F. Pond, Lieutenant U. S. Navy) Greene, Pittonia 1: 288. 1889.—“San Bartolome Bay . . . in the month of March, 1889 . . . on low plains around the southern shore of the Bay.”—Holotypus, labeled in Greene’s hand “*Astragalus Pondii* Greene,” but with no further data, ND!—*A. insularis* var. *Pondii* (Greene) Jones, Rev. Astrag. 104. 1923. *Phaca Pondii* (Greene) Rydb. in N. Amer. Fl. 24: 351. 1929.

The Cedros milk-vetch, var. *insularis*, is a pretty little astragalus, notable for the deep green color of the leaves, rather distant acute or subacute leaflets, tiny magenta-purple (when dry violet) flowers, and strongly asymmetric pod ventrally carinate by the prominent, nearly straight suture and speckled with anthocyanic pigment. The species was described from plants of diminutive stature which bore unusually small fruits, but more vigorous and leafy examples have since been obtained on Cedros (e.g., *Haines & Hale in 1939*, RSA) and these closely match the astragalus on the adjoining mainland described as *A. Pondii* Greene. Nevertheless, the insular race, however well nourished, has at least on the average smaller fruits than the populations around San Bartolomé Bay. It should be noted that *Phaca Pondii* as interpreted by Rydberg (1929, p. 351) is in substance our var. *quentinus* described below.

The differential characters of *A. piscinus*, *A. Vaseyi*, and *A. idrietorum*, other species with small, purple flowers and bladdery fruits, which are native to Baja California and likely to be confused with *A. insularis* or its var. *quentinus*, are discussed under the heading of *A. idrietorum*.

282b. *ASTRAGALUS INSULARIS* var. *QUENTINUS*

More densely pubescent than var. *insularis*, the herbage greenish-cinereous, the leaflets glabrous above; stems 0.6–2.5 dm. long; leaflets (7) 11–19, narrowly elliptic, acute; pod (0.9) 1.1–1.8 cm. long, (7.5) 10–14 mm. in diameter, subsymmetrically ovoid or subglobose, the beak very short and obscure, 1–2.5 mm. long, the funicular flange 0.3–0.5 mm. wide.—Collections: 8 (o); representative: *Wiggins 5217* (CAS, DS, NY, UC), *5244* (CAS, NY, POM, UC); *Palmer 719* (P, K, NY); *Raven, Mathias & Turner 12,452* (CAS).

Sandy plains, alkaline flats, stony washes, and openings in coastal scrub, sometimes on burns, 10–600 feet, locally plentiful but known only from San Quintín Bay and south to the north edge of the Viscaíno Desert, on the Pacific side of the Baja California peninsula in lat 30°–30° 50' N.—Map No. 116.—February to April.

ASTRAGALUS INSULARIS var. *QUENTINUS* (of San Quintín) Jones, Contrib. West. Bot. 8: 6. 1898 (“*Quentinus*”). “. . . the type specimens are from San Quentin, Lower California, collected by Orcutt.”—Holotypus (*Orcutt 1327*), collected April 22, 1886, UC! isotypus, NY! phototypus, POM!

The San Quintín milk-vetch, var. *quentinus*, differs from other forms of *A. insularis* in its subsymmetrically ellipsoid or almost globose, obscurely beaked or almost beakless pod, and from var. *insularis* (with which it has in common leaflets acute and glabrous above) in being more densely pubescent, with ashen rather than deep green foliage. The pod greatly resembles that of *A. Wootoni* in outline, but the plants may be distinguished from all phases of that species by their acute leaflets and short calyx-teeth; in addition, the pod is of thinner texture, speckled with reddish-purple, and mostly 8–10- rather than 12–20-ovulate. There can be no

doubt that its immediate relationship lies with *A. insularis*, as Jones clearly realized, and not with the allopatric *Candolleanae* of *Phaca* with which Rydberg associated it (1929, p. 351) under the title of *P. Pondii*. It so happens that the isotypus of var. *quentinus* most readily available to Rydberg (that at NY) is an uncommonly robust sample of the variety, and might be interpreted as a short-lived perennial. However, other material from San Quintín Bay and nearby Socorro show that the plants are normally fleeting annuals of three or four months duration.

282c. ASTRAGALUS INSULARIS var. HARWOODII

Stems 0.4–0.35 (5.5) dm. long; *leaflets* (9) 11–19 (21); *pod* 1.4–2.3 cm. long, (5) 6–12 (15) mm. in diameter, rounded or broadly obconic at base, contracted distally into a slightly incurved beak $\pm$ 4–7 mm. long, the ventral suture straight or nearly so, the dorsal one gibbous-convex, the funicular flange variable in width, 0.2–1.5 mm. wide.—Collections: 24 (o); representative: *Hall* 5945 (POM); *J. & L. Roos* 4241 (RSA); *Munz* 15,811 (POM); *Keck* 4222 (POM); *MacDougal* 227 (NY, p. p.); *Benson & Darrow* 10,916 (ARIZ, POM); *Wiggins* 8383 (DS).

Open sandy flats and sandy or stony desert washes, with *Larrea*, 30–1200 feet, locally plentiful in scattered stations in the Colorado Desert, California (Pinto Basin and Chuckwalla Valley, Riverside County, south to extreme eastern San Diego County) and adjoining Arizona (Yuma County), south to the Colorado Delta in extreme northeastern Baja California, and to the Sonoita Valley and (sometimes on sea sands) head of the Gulf of California in northern Sonora; apparently isolated in the Desierto de San Julián and on Angel de la Guardia and San Lorenzo Islands in the Gulf of California at $\pm$ 28° 35'–29° 30' N.—Map No. 116.—January to May.

ASTRAGALUS INSULARIS var. HARWOODII (Robert Daniel Harwood, 1899–) Munz & McBurney ex Munz in Bull. S. Calif. Acad. Sci. 31: 66. 1932.—“Type from Blythe Junction, Colorado Desert, *Munz & Harwood* 3592 . . .”—Holotypus, collected April 2, 1920, POM! isotypus, US!—*A. Harwoodii* (Munz & McBurney) Abrams, Ill. Fl. Pac. St. 2: 586, fig. 2836. 1944.

As it occurs in California and immediately adjoining states, the Harwood milk-vetch agrees in all essential particulars with var. *insularis* except that the whole plant is more densely pubescent and the leaflets (on the average slightly more numerous) are obtuse or emarginate and hairy on both sides. A collection from Sierra Calvario in the Viscaíno Desert (*Gentry* 7514, ARIZ) would be referred to var. *Harwoodii* on the basis of the vesture but has acute leaflets as in var. *insularis*, to which it is evidently transient. Fruiting plants collected on San Lorenzo Island in the Gulf of California (*Johnston* 3538, cited as *A. insularis* by Johnston in Proc. Calif. Acad. Sci. IV, 12: 1042. 1924) are referred with hesitation to var. *Harwoodii* because of their cinereous stems and leaves, but they differ from the form common in the Colorado Desert in their unusually narrow, lance-ellipsoid pods and subacute leaflets. A few seeds from this collection, although over thirty years old at the time, germinated readily under glass in 1956 (cultivated spm. at CAS); the plants had the characteristic flower of *A. insularis* but retained the narrow pod of the parent. Possibly Johnston's plant represents a fourth variety of the species.

Along the north edge of the Colorado Desert the var. *Harwoodii* and the related *A. nutans* grow close together, although probably not in the same habitats. The latter is distinguished by its fewer (7–13) leaflets, substantially larger flower, and 10–12 pairs of ovules in the pod.

283. ASTRAGALUS GEYERI

Commonly very slender, fugitive, erect or diffuse annuals, with slender or filiform taproot, rarely persisting into a second season, strigulose with straight, appressed hairs, the stems usually canescent, the herbage cinereous in youth becoming greenish in age, the leaflets glabrous or medially glabrescent above; *stems* 1–20 cm. long, in the first year solitary or 3, the lateral ones arising from the cotyledonary axils, either simple and erect or commonly branched or spurred at the first 2–4 nodes, the prostrate or incurved-ascending branches elongating

and often longer than the main axis, in the rare biennial state several arising from the indurated but scarcely caudiciform crown of the first season, together forming low, densely leafy tufts; *stipules* thinly herbaceous or submembranous, deltoid, deltoid-acuminate, or the uppermost ones lanceolate, 1.5–4 mm. long, semiamplexicaul, often more thinly pubescent dorsally than the adjacent stem and thereby forming a greenish spot; *leaves* (1.5) 2–10 cm. long, all petioled, with 3–13 rather distant, linear-elliptic, -oblong, or broadly oblong-elliptic, obtuse or retuse, folded or flat leaflets 3–17 mm. long; *peduncles* incurved-ascending, 0.6–2.5 cm. long, usually filiform, the first commonly produced at about the third or fifth node and thence upward along the stem, the earliest often appearing subradical; *racemes* loosely 2–8-flowered, the flowers at first ascending, declined in age, the axis little elongating, 3–15 mm. long in fruit; *bracts* membranous, ovate or lanceolate, 0.7–2 mm. long; *pedicels* at anthesis 0.6–1 mm. long, in fruit arched outward, a little thickened, 0.8–1.5 mm. long, persistent; *bracteoles* 0–2, minute when present; *calyx* 2.7–3.8 mm. long, strigulose with white or some dark hairs, the disc 0.4–0.7 mm. deep, the campanulate tube 1.6–2.4 mm. long, 1.5–2 mm. in diameter, the subulate or lance-subulate teeth 0.7–1.5 mm. long; *petals* whitish with faintly lilac-tipped keel, the banner sometimes suffused or veined with pale lilac, rarely all purple with a white eye, then drying violet; *banner* recurved through ± 45 (rarely 80)°, ovate- or oval-cuneate, shallowly notched, 5.2–7.6 mm. long, 3–4.8 mm. wide; *wings* 4.6–6.5 mm. long, the claws 1.7–2.4 mm., the oblanceolate to narrowly obovate, obtuse or obscurely emarginate, straight or lunately incurved blades 3–4.9 mm. long, 1.3–2.1 mm. wide; *keel* 3.8–4.8 mm. long, the claws 1.8–2.3 mm., the half-obovate or -circular blades 2.1–2.9 mm. long, 1.4–1.6 mm. wide, strongly incurved through 100–120° to the obtuse, deltoid apex; *anthers* 0.2–0.35 (0.4) mm. long; *pod* spreading or loosely declined (often humistrate), sessile, lunately or very obliquely half-ovoid, bladdery-inflated, 1.5–2.4 cm. long, 6–10 (or when pressed apparently up to 13) mm. in diameter, cuneate at base, contracted distally into a deltoid or triangular-acuminate beak, the body a trifle laterally compressed and obscurely triquetrous with rounded faces and angles (or the ventral angle sometimes acute), the ventral suture straight or more commonly concave in profile, the dorsal one gibbous-convex, the thin, pale green, sometimes purple-cheeked, finely white-strigulose valves becoming papery, stramineous, delicately cross-reticulate, not or narrowly inflexed; *dehiscence* apical, after falling; *ovules* 7–18; *seeds* olive- or yellowish-brown, sometimes purple-dotted, smooth or nearly so, 2.2–3 mm. long.

Over the greater northern half of its range the Geyer milk-vetch is the only annual species of its genus. It flowers early in the year, producing its characteristic fruit within a few weeks of germination of the seed and consequently is easily recognized. The pod is more strongly oblique than in all other *Inflati* except *A. pubentissimus*, a much coarser, villosulous plant with larger flowers and lustrously long-hairy fruits. At the south end of its range the species has given rise to a strongly differentiated variety, distinguished as follows:

Key to the Varieties of *A. Geyeri*

1. Pod strictly unilocular, the dorsal suture sometimes raised within as a filiform line but not at all inflexed; *leaflets* or most of them linear-oblong or -oblanceolate; widespread, but not in n.-w. Arizona or immediately adjoining Nevada 283a. var. *Geyeri*
1. Pod semibilocular, the valves inflexed dorsally as a narrow septum; *leaflets* broadly oblong or elliptic; n.-w. Arizona and extreme s. Nevada 283b. var. *triquetrus*

283a. *ASTRAGALUS GEYERI* var. *GEYERI*

Annual or occasionally perennant; *leaflets* (3) 7–13, linear-oblong, narrowly oblanceolate, or linear-elliptic, rarely (in some lower leaves) obcordate, 3–17

mm. long, the terminal one nearly always longer than the last pair; *pod* rounded dorsally; *ovules* 10–18.—Collections: 63 (xiv); representative: *C. P. Smith* 3654 (DS); *J. & C. Christ* 16,695, 18,546 (NY, RSA); *Ripley & Barneby* 6514 (CAS, IDS, RSA); *Palmer* 294 in 1893 (WIS); *C. L. Hitchcock* 15,755 (NY, RSA, WS); *Peck* 21,827, 25,759 (CAS, RSA, WILLU); *E. Nelson* 4911 (NY); *Eastwood & Howell* 9469 (CAS, WS); *Holmgren* 1067 (UTC, WS); *Jones* 1781 (CAS, NY, POM); *Holmgren & Hansen* 3289 (NY, WS).

Sandy flats and valley floors, depressions in mobile or stabilized dunes, and along draws in gullied bluffs or knolls, mostly 2500–5500 feet, to the south with *Larrea*, northward with sagebrush, widely dispersed over the Great Basin and common locally, from westcentral Nevada and adjoining California to southeastern Oregon, the Snake River plains in southern Idaho, and the Colorado Basin in east-central Utah, extending more rarely northeast and up to 7000 feet to the upper forks of the North Platte and Wind Rivers in Wyoming; apparently isolated at about 400 feet at the Great Bend of the Columbia River in southeastern Washington (Walla Walla County).—Map No. 122.—Late April to July (August).

ASTRAGALUS GEYERI (Charles Andreas Geyer, 1808–1853, Austrian plant collector, crossed the continent in 1843–4) Gray in Proc. Amer. Acad. 6: 214. 1864, based on *Phaca annua* (annual) Geyer in Lond. Jour. Bot. 6: 213. 1847.—“... in the drift-sand plains of the Upper Platte River... (n. 1).”—Holotypus, K! isotypi, BM, G, GH, OXF, P!—Non *A. annuus* DC., 1802.

The typical form of the Geyer milk-vetch is a lowly and inconspicuous plant, although pretty enough at close quarters, when the beauty of the greatly oblique, bladderly fruits of papery-membranous texture and the symmetry of the tiny, whitish or (in northcentral Nevada) rarely purple flowers can be appreciated. Other notable features of var. *Geyeri* are its few leaflets of narrow outline, of which the terminal one is usually much the longest, and the production of the first fruiting racemes close to the ground on what appear, to the casual glance, subradical scapes. The species is not very variable. In Nevada, Utah, Oregon, and Idaho it is found in the hottest and most arid valleys where its life span is ordinarily a matter of three or four months. A shower at the critical moment may prolong its active days until the base of the stems and the taproot become a little indurated or woody; even so it is in this area a true monocarpic annual. In the cooler climate around the foothills of the Sweetwater Mountains in Wyoming, where *A. Geyeri* reaches an altitude of 7000 feet, the plants tend to persist into a second season. In Sweetwater County, Ripley and I found one colony in which every individual plant had come through the preceding winter and none had germinated as yet from last year's seed. More commonly, however, diminutive annual and first-year plants are found in flower and fruit simultaneously, together with the low, tufted, basally indurated biennial phase. While there seems to be something individual about these Wyoming populations, they do not differ in the form of their essential parts.

The Geyer milk-vetch is known for certain in California only from one spot in eastern Mono County, just across the Nevada line. It is to be expected, and has perhaps been found, in the Basin sector of Lassen or Sierra County. A specimen labeled “California” (*Lemmon* 66 in 1875, NY) may have come from the northeast corner of the State, but the record needs authenticating.

The first collection of *A. Geyeri* dates back to Douglas's exploration of the Columbia Basin. His specimens are dated 1830 (BM) and 1835 (K), but the only locality recorded was “Oregon.”

283b. *ASTRAGALUS GEYERI* var. *TRIQUETRUS*

Always annual; *leaflets* (5) 7–9, broadly oblanceolate or elliptic, mostly retuse, 4–15 mm. long, pubescent on both sides, flat, the terminal one not conspicuously longer than the last pair; *pod* more definitely trigonous than that of var. *Geyeri*, openly sulcate dorsally, the valves inflexed as a narrow partial septum 0.6–1.2 mm. wide; *ovules* 7–11.—Collections: 3 (o); representative: *Eastwood & Howell* 9000 (CAS, RSA); *Peebles & Parker* 14,678 (NY).

Sandy flats and washes, with *Larrea*, 1500–2000 feet, rare and local, along and near the lower Muddy, Virgin, and Colorado Rivers in extreme northwestern

Mohave County, Arizona, and southern Clark County, Nevada.—Map No. 122.—April and May.

ASTRAGALUS GEYERI var. *TRIQUETRUS* (Gray) Jones, Contrib. West. Bot. 8: 7. 1898, based on *A. triquetrus* (three-cornered, of the pod) Gray in Proc. Amer. Acad. 13: 367. 1878.—“Southeastern borders of Nevada, at the confluence of Muddy River with the Virgin, Dr. Palmer, 1877.”—Holotypus (from “Muddy River at St. Thomas”), GH!—*Phaca triquetra* (Gray) Rydb. in N. Amer. Fl. 24: 353. 1929.

The var. *triquetrus* is one of the rarest desert milk-vetches, known only from the Arizona Strip near Beaver Dam, from the now inundated type-station, and from the Valley of Fire near Crystal. It has been collected only seldom and in very small quantity, and nothing is known at present of potential variation within it. It is distinguished at sight from var. *Geyeri* by its few broad leaflets pubescent on both faces, although the habit of growth is essentially the same. The pods of the two varieties are alike in profile, but that of var. *triquetrus* is not only grooved along the back and semibilocular but also encloses slightly fewer seeds. In the context of the section var. *triquetrus* is strongly marked and may perhaps deserve its original specific status.

284. *ASTRAGALUS ARIDUS*

Annual, of 2–4 months duration, variable in stature, either low and very slender or becoming robust and coarse in favorable seasons, with a slender or subfiliform taproot, densely strigulose-pilosulose (-pilose) with fine, shorter, appressed and straight together with some or many longer, straight or subsinuous and narrowly ascending hairs up to 0.6–1.1 mm. long, the stems and herbage silky- or almost satiny-canescient, the leaflets equally pubescent on both sides; *stems* solitary and erect in small plants, more commonly 3 from the root-crown and these often branched or spurred at each node preceding the first peduncle, decumbent with ascending tips or eventually diffuse and trailing, (2.5) 5–30 cm. long; *stipules* thinly herbaceous becoming papery, commonly purplish, ovate, triangular, or triangular-acuminate, 1.5–5 (6.5) mm. long, $\pm$ semiamplexicaul-decurrent; *leaves* (2) 3–9 cm. long, petioled but the uppermost shortly so, with (7) 9–17 oblanceolate, oblong-oblanceolate, or elliptic, obtuse, truncate, or emarginate, flat or loosely folded leaflets 4–16 mm. long; *peduncles* incurved-ascending, 2–5.5 cm. long, shorter than the leaf; *racemes* loosely (3) 4–9-flowered, the flowers ascending, the axis elongating, 1.5–5.5 cm. long in fruit; *bracts* subherbaceous, ovate or lanceolate, 0.8–2.2 mm. long; *pedicels* ascending, straight or a trifle arched outward in age, at anthesis 0.2–0.5 mm., in fruit thickened, 0.5–1 mm. long, persistent; *bracteoles* 0; *calyx* 3.3–4.3 mm. long, densely silvery-pilose with white and rarely a few black hairs, the subsymmetric disc 0.6–0.9 mm. deep, the turbinate-campanulate tube 2.1–2.7 mm. long, 1.5–2.3 mm. in diameter, the broadly subulate, herbaceous teeth 1–1.6 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish faintly tinged with pink-lilac or flesh-color, drying stramineous, only slightly or (when small) often irregularly graduated, the wings then either a trifle shorter than the keel or longer than the banner; *banner* recurved through $\pm 40^\circ$, obovate-cuneate or broadly elliptic, shallowly but openly notched, (3.3) 3.5–6.5 mm. long, 2.5–3.8 mm. wide; *wings* 3.6–5.4 mm. long, the claws 1.4–2.3 mm., the oblong or oblong-oblanceolate, obtuse, straight or slightly incurved blades 2.1–3.7 mm. long, 1–1.6 mm. wide; *keel* 3.6–5 mm. long, the claws 1.4–2.5 mm., the obliquely obovate or nearly half-circular blades 2.1–3 mm. long, 1.4–2 mm. wide; *anthers* 0.25–0.4 mm. long; *pod* ascending, sessile on the receptacle, half-elliptic or lunately elliptic in profile, 1–1.7 cm. long, 4.5–7 mm. in diameter, a little inflated but scarcely bladdery, cuneate and laterally compressed at both ends, but strongly compressed only in the triangular beak, at the middle terete or very slightly compressed, the sutures both filiform, the ventral one straight or gently concave, the dorsal one convex, the thin, canescently strig-

ulose-pilous valves becoming papery but opaque, obscurely reticulate, not inflexed, the funicular flange subobsolete, not over 0.2 mm. wide; *dehiscence* apical, after falling, the beak narrowly gaping; *ovules* (3) 4–6 (7); *seeds* ochraceous or chestnut-brown, often purple-dotted, pitted or wrinkled, dull, 2.7–3.7 mm. long.—Collections: 17 (ii); representative: *Jones* (from Yuma) in 1906 (CAS, NY, POM); *L. S. Rose* 37,155 (CAS); *Abrams* 3220 (NY); *Ripley & Barneby* 10,085, 10,091 (CAS, RSA); *MacDougal* 227 (NY, p. p.).

Dunes and open sandy plains and valley floors, 200 feet below to 1200 feet above sea level, locally abundant in the *Larrea* zone of the Colorado Desert from Salton Sea to Borrego Valley, Imperial Valley, and along the lower Colorado from Palo Verde Valley south to Yuma Desert, southeastern California and immediately adjoining Arizona, Sonora, and Baja California.—Map No. 124.—February to April (May).

ASTRAGALUS ARIDUS (dry) Gray in Proc. Amer. Acad. 6: 223. 1864.—“Interior Californian desert, on the route between the mouth of the Gila River and San Diego, Dr. Thurber.”—Holotypus, GH!—*Tragacantha arida* (Gray) O. Kze., Rev. Gen. 943. 1891. *Phaca arida* (Gray) Rydb. in N. Amer. Fl. 24: 354. 1929.

Astragalus albus (whitened) Sheld. in Minn. Bot. Stud. 1: 128. 1894.—“Collected in the Colorado desert, in southeastern California, Ap. 1899, by C. R. Orcutt.”—Holotypus, so labeled, MINN!

The parched milk-vetch, *A. aridus*, is a most distinct species, recognized at a glance by its obviously annual root, silvery or satiny pubescence extending up to the small, ascending, turgid but scarcely bladderly fruits, and its tiny, flesh-pink flowers which turn straw-color in drying. The detached pod of *A. aridus* is rather similar in form to that of some phases of *A. Palmeri*, a potential perennial with more numerous and substantially larger, purple flowers native to the west edge of the Colorado Desert. I suspect that the two species may have arisen from a remote common source, although *A. aridus* has no really close allies. The two other annual *Inflati* found on the floor of the Salton Sink are *A. insularis* var. *Harwoodii*, distinguished by its short, strigulose indumentum, magenta-purple (when dry violet) flowers, and papery-membranous, greatly swollen, purple-speckled pod, and the coarsely hirsutulous *A. sabulonum* with its declined, villous pod of firmly chartaceous texture. In both of these the ovules are less than eight only in very rare instances, in contrast to the common counts of four, five, and six in the parched milk-vetch. The smallest flowers of *A. aridus* have petals slightly shorter than the calyx-teeth and a poorly developed banner sometimes shorter than the wings. Such flowers are self-fertilized and are nearly if not truly cleistogamous.

LXIX(iv). Subsectio SPARSIFLORI

Annuals and short-lived perennials; *leaflets* 7–17 (19); *racemes* 2–15-flowered; *petals* white, sometimes pink-veined or -suffused; *pod* sessile, sometimes elevated on a gynophore, ovate to linear-oblong in profile, oblique or incurved, not inflated, turgid, or incipiently bladderly, uni- to subbilocular; *ovules* 6–15.—Spp. 3, of the southern Rocky Mountains in Colorado, and of the John Day and lower Columbia Valleys in interior Oregon and adjoining Washington.

ASTRAGALUS sect. INFLATI subsect. SPARSIFLORI (Jones), stat. nov., based on *Astragalus* sect. *Sparsiflori* Jones, Rev. Astrag. 128. 1923.—Sp. lectotypica: *A. sparsiflorus* Gray.

As defined above, subsect. *Sparsiflori* is not technically separable from subsect. *Aridi* or logically tenable as a separate group. The first species, *A. Wetherilli*, has every macroscopic feature in common with the *Aridi*, and the same might be said of some forms of *A. diaphanus*. These are carried over into a subsection apart in order to detach the more specialized *A. sparsiflorus* in which, as in some forms of *A. diaphanus*, the pod is little inflated and semibilocular in addition. Attention is drawn below to peculiar racial situations existing in *A. sparsiflorus* and *A. diaphanus*, each in its way unique in the genus. The chromosomes of *A. diaphanus* as described by Head (1957) are unusual in number and small size. Unfortunately, there is no cytogenetic data for the other *Sparsiflori*. For the present I can only point to a marked similarity among the three species in growth-habit, leaves, and flowers, and even in such imponderable details as coloring of the foliage and petals. Despite the great variation in size and shape

of the pods, there can be little doubt that the *Sparsiflori* form a natural assemblage of forms; the status of the group, nevertheless, remains open to controversy.

The inflated *Sparsiflori* were referred by Jones (1923) to his sect. *Inflati* and by Rydberg (1929) to *Phaca*, where *P. diurna* (= our *A. diaphanus* in part) was associated in subgen. *Chartocystis* sect. *Annuæ* (= our subsect. *Aridi* in part) with *A. Geyeri*, whereas *P. Wetherilli*, because of its short gynophore, was misplaced among the *Megacarpæ* of subgenus *Podocystis*. To find *A. drepanolobus* (= our *A. diaphanus* in part) one must turn to Jones's *Hamosi* or to Rydberg's *Hamosa* sect. *Tricarinatae* (1927, p. 21). Meanwhile *A. sparsiflorus* had become for Jones the prototype of a small sect. *Sparsiflori* composed otherwise of our *Villosi* subsect. *Austro-Orientales*, all of which were later transferred by Rydberg (1929) to a third genus *Batidophaca*. There can be few clearer examples of how deeply taxonomists can disagree according to the emphasis placed upon a particular morphological feature (in this case the pod) as an index to relationship between organisms. It is worth recalling that the semibilocular pod of *A. Geyeri* var. *triquetrus* did not prevent its inclusion with the obviously related *A. Geyeri* var. *Geyeri* in sect. *Inflati* sensu Jones or *Phaca* sensu Rydberg; and Rydberg made a special exception in his generic key to the *Astragalanae* (1929, p. 252) in order to admit the so-called *A. Craigi* (= a form of *A. diaphanus* with pod moderately inflated but narrowly septiferous) to the ranks of the technically unilocular genus *Phaca*. The circumscription of sect. *Sparsiflori* adopted here derives from an extension of these insights.

285. ASTRAGALUS WETHERILLI

Perennial but of rapid growth and short duration, commonly flowering the first season, low and diffuse, with a slender taproot and superficial root-crown, thinly strigulose with fine, straight, appressed hairs up to 0.3–0.45 mm. long, the stems subcinereous, the herbage green or greenish, the leaflets glabrous above; stems about 5–10, decumbent and ascending, 0.4–2.4 dm. long, purplish at least at base, shortly branched or spurred at most axils preceding the first peduncle, the upper spurs sometimes paired with an inflorescence at the same axil; stipules 1.2–3.5 mm. long, thinly herbaceous becoming papery or membranous, ovate or triangular, subacute or acuminate, semi- or the lowest fully amplexicaul but free, glabrous dorsally, ciliate; leaves (2) 3.5–10 cm. long, with slender petioles and 7–15 broadly obovate or oval, obtuse or shallowly emarginate but often also minutely mucronulate, flat, thin-textured leaflets (3) 5–14 mm. long; peduncles slender or subfiliform, ascending or commonly incurved, 1.5–4.5 cm. long; racemes loosely 2–9-flowered, the flowers at first anthesis ascending, early horizontal or a trifle declined and secund, the axis 0.3–2.3 cm. long in fruit; bracts submembranous, commonly purplish, ovate or lanceolate, 1–2.5 cm. long; pedicels at anthesis ascending, straight, 1–2.1 mm. long, in fruit spreading or gently arched, 1–2.5 mm. long, persistent; bracteoles 0; calyx 4.6–5.6 mm. long, strigulose with pale or some black hairs, the subsymmetric, obconic disc 0.5–0.9 mm. deep, the pallid or purplish, campanulate tube 2.8–3.6 mm. long, 2.1–2.7 mm. in diameter, the lance-subulate teeth 1.8–2 mm. long; petals whitish, tinged or veined with lavender; banner recurved through 45°, obovate-cuneate or subrhombic-obovate, 7.5–10.7 mm. long, 4.4–6.6 mm. wide; wings 6.5–9.5 mm. long, the claws 2.7–4.1 mm., the blades narrowly obovate-oblong, slightly incurved, 4.4–7 mm. long, 1.7–2.7 mm. wide, faintly notched at apex or on the lower margin just below the obtuse apex, the blade of the left one infolded; keel 6.5–8 mm. long, the claws 2.8–4 mm., the half-obovate blades 3.8–5 mm. long, 2–2.4 mm. wide, abruptly incurved through 90–100° to the deltoid, sometimes obscurely porrect apex; anthers 0.4–0.6 mm. long; pod loosely spreading or declined, sessile but elevated on a slender, stipelike gynophore 1–2.5 mm. long, obliquely ovoid-ellipsoid, slightly incurved, 1.4–2 (2.2) cm. long, 6–10 (or when pressed seemingly up to 13) mm. in diameter, inflated but not strongly bladdery, broadly obconic at base, contracted distally into an almost erect or gently incurved, triangular, laterally compressed beak, otherwise a trifle obcompressed, very shallowly grooved along one or both sutures, the thin, greenish, often purple-speckled, minutely strigulose valves be-

coming papery, stramineous or brownish, finely reticulate, not inflexed, the funicular flange 0.5–1.4 mm. wide; *dehiscence* apical, through the beak, after falling; *ovules* 9–13; *seeds* dark or chestnut-brown, smooth or minutely punctate, dull, 2.4–2.7 mm. long.—Collections: 4 (ii); representative: *Wm. A. Weber* 3326 (CAS, RSA, TEX, WS); *Barneby* 12,741 (CAS, NY, RSA).

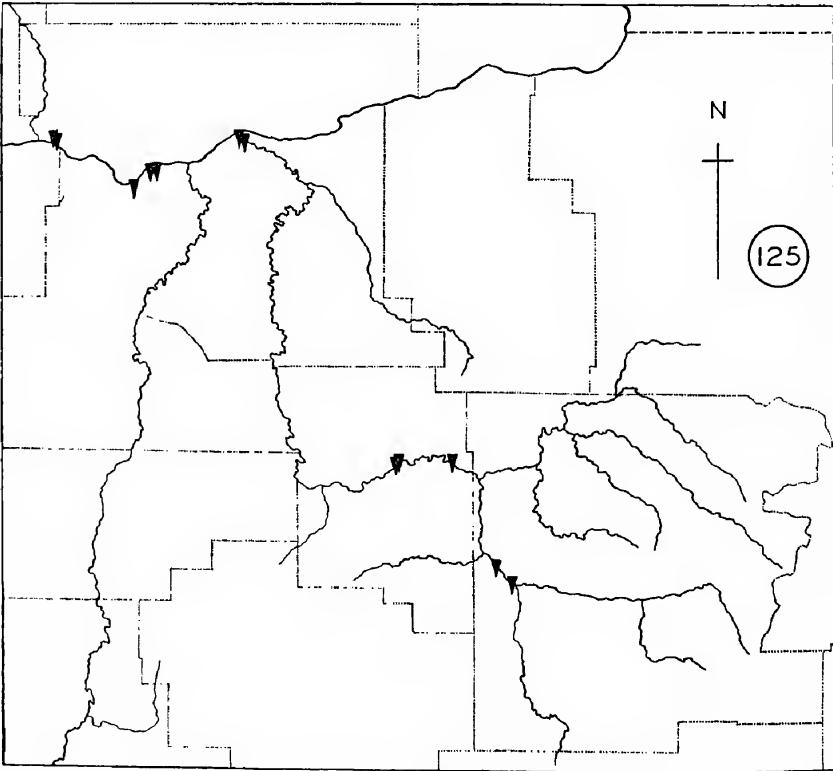
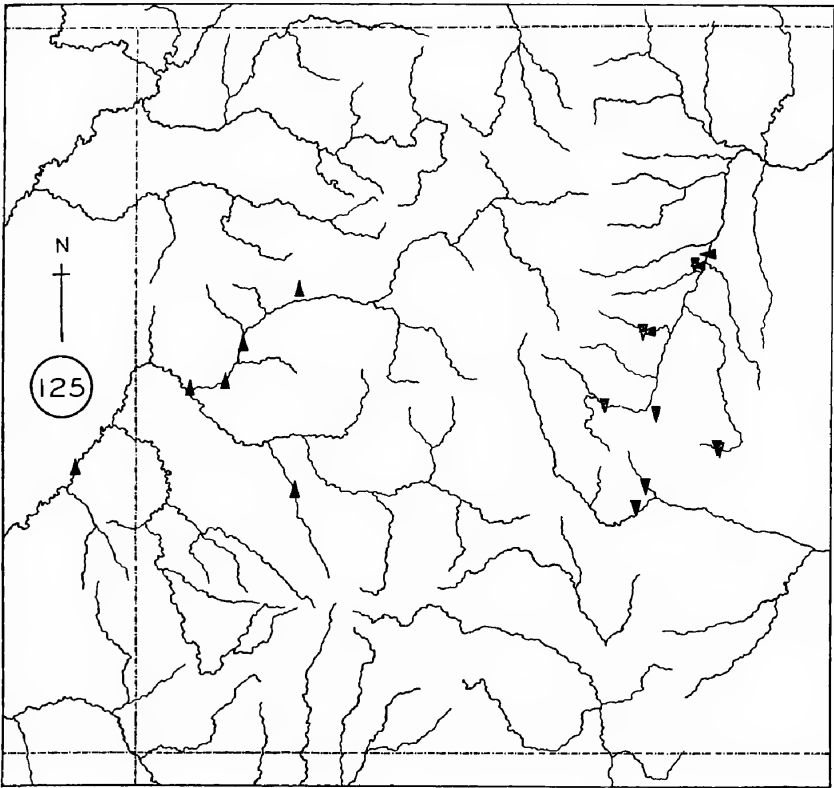
Steep slopes, canyon benches, and talus under cliffs, in sandy clay soils derived from shale or sandstone, with sagebrush and junipers, 4700–5850 feet, rare and local along the Grand and lower Gunnison Rivers and immediately affluent creeks, from near Moab, Grand County, Utah, upstream into Mesa, Montrose, and Garfield Counties, westcentral Colorado.—Map No. 125.—May and June.

ASTRAGALUS WETHERILLI (Benjamin Alfred Wetherill, 1861–1950, archeological explorer) Jones in *Zoë* 4: 34. 1893.—“Collected at Grand Junction, Colo., May, 1892, by Miss Alice Eastwood.”—Holotypus, actually from the Grand River canyon above Grand Junction, POM! isotypi, CAS, GH, MO, ND, NY (fragm.), RM, US!—*Phaca Wetherilli* (Jones) Rydb. in Bull. Torr. Club 32: 665. 1905.

The Wetherill milk-vetch is a modest, rather pretty species, notable chiefly for its few and small, white or whitish flowers, its few (3–7) pairs of broad, thin-textured leaflets, and its obliquely ovoid pods elevated out of the calyx on a short but evident gynophore. The species has little else in common with the other gynophorous *Inflati* (*A. serpens*, *A. nutans*, and *A. fastidius*); the production of the receptacle has clearly occurred several times independently in the section. Likewise the species has no close relationship with the *Megacarpi* with which Rydberg (1929, p. 338) associated it in *Phaca* subgen. *Podocystis*; they are alike only in the parallel evolution of a gynophore, differing greatly in form and proportion of the flowers. Jones (1923, p. 114, Pl. 72) placed the Wetherill milk-vetch next after *A. allochrous* but overlooked an even closer affinity to *A. sparsiflorus* (and especially its var. *majusculus*), a species which occupies a similar, though somewhat moister ecological niche on the opposite slope of the Continental Divide in about the same latitudes. In *A. sparsiflorus* the flowers are almost identical in form, but a little smaller, and the pod is sessile or nearly so, not inflated, and provided with a very narrow, hyaline, partial septum. The existence of unilocular, inflated and almost fully bilocular, uninflated fruits in different forms of *A. diaphanus*, a third closely related species of interior Oregon and the lower Columbia Valley, shows how easily the fruits in the immediate group may become modified by mutations involving no other visible feature of the plant-body.

286. ASTRAGALUS SPARSIFLORUS

Slender, diffuse or prostrate, annual or perennial of short duration usually flowering the first season, with a slender taproot and pluricipital root-crown at soil-level, strigulose with straight, appressed or some narrowly ascending hairs up to 0.2–0.7 mm. long, the herbage green or subcinereous, the leaflets glabrous above; *stems* several or numerous, sometimes solitary or few in seedling but already fruiting individuals, prostrate or decumbent, (3.5) 7–33 cm. long, branched or spurred at almost all axils up to the first peduncle and the spurs sometimes reduced upward to a naked peduncle, the racemes thus appearing paired in some distal axils; *stipules* ovate to lance-acuminate, 1–4 mm. long, all but the lowest herbaceous or submembranous but greenish, at most semialexicaul; *leaves* 1.5–10.5 cm. long, shortly petioled or the uppermost sessile, with (7) 9–19 oblong-oblancheolate to obovate or obcordate, obtuse or emarginate, flat or loosely folded leaflets 2–15 mm. long; *peduncles* slender or filiform, 1–7.5 cm. long, mostly shorter than the leaf; *racemes* loosely (1) 2–10-flowered, the flowers ascending or spreading in age, the axis not much elongating, (0) 0.5–4 cm. long in fruit; *bracts* submembranous, pallid or purplish, narrowly ovate or lance-acuminate, 1–2.5 mm. long; *pedicels* ascending, straight or a little arched in age, at anthesis 1–1.7 mm., in fruit not or but little thickened, 1.5–3.5 mm. long, persistent; *bracteoles* commonly 2, minute; *calyx* 3–4.3 mm. long, white- or partly black-strigulose, the symmetric disc 0.3–0.7 mm. deep, the subulate teeth as long



or half as long as the campanulate tube, the whole becoming papery, ruptured or not, persistent; *petals* white with pink-veined banner and pink- or purple-tipped keel; *banner* 5.5–8 mm. long; *wings* nearly as long or slightly shorter; *keel* 3.6–5 mm. long, the blades incurved through 120–130° to the bluntly deltoid apex; *anthers* 0.25–0.4 mm. long; *pod* ascending, spreading, or loosely declined, sessile or elevated on a conical gynophore hardly longer than the disc, lunately oblanceolate or obliquely half-obovate in profile, (5) 6–26 mm. long, 2.7–5 mm. in diameter, subtriquetrously compressed, ventrally carinate by the suture, openly sulcate dorsally, the thin, green, purplish, or purple- or red-mottled, finely strigulose valves becoming papery, brownish or stramineous, delicately cross-reticulate, inflexed as a very narrow and incomplete, hyaline septum 0.1–0.6 mm. long, or this sometimes (in var. *sparsiflorus*) obscure or obsolete; *dehiscence* apical, from the beak downward through the ventral suture, after falling; *seeds* brown, smooth or sparsely pitted, 1.7–2.7 mm. long.

The Front Range milk-vetch, *A. sparsiflorus*, is subject to the most singular type of variation, being represented in its restricted range by two abruptly different types which, if they did not sometimes occur in close association, would undoubtedly deserve the specific rank to which Rydberg raised them in the genus *Tium*. I am inclined to view var. *majusculus*, the rarer of the two forms and apparently confined to the valley of the South Platte from Denver upstream about forty or fifty miles, as the more primitive. It has more in common with *A. Wetherilli* and *A. diaphanus* in general appearance, in fine detail of form and curvature of the petals, and in ovule-number, while the pod seems to me of a more generalized form than that of var. *sparsiflorus*, although still highly modified relative to other *Inflati*. The two varieties are found together on the South Platte in Park and Denver Counties, but var. *sparsiflorus* extends south to the foothills of Pike's Peak and to the Arkansas River in Fremont County. It differs from var. *majusculus* in the abbreviation or attenuation of nearly all its several parts exclusive of the main stem-axis. Thus the mostly oblong-oblanceolate or obovate leaflets of var. *majusculus* (obcordate only in some lower leaves) become in var. *sparsiflorus* all greatly shortened and proportionately wider; the leaf-rachis and peduncles become shorter and filiform. The tube of the calyx (but not always the teeth) is shortened, and the petals likewise, but the latter, following a pattern common in the genus, become with shortening more strongly and abruptly incurved. Finally the pod, although it is fashioned after the same basic plan, is $\frac{1}{2}$ – $\frac{1}{3}$ shorter than that of var. *majusculus* and of plumper outline, while the ovules are reduced in number from 5–8 to 3–4 pairs. All the collections of *A. sparsiflorus* that have been examined fall neatly into one or the other category; no evidence of intergradation between the two forms has been put forward. Along the North Fork of the South Platte near Shawnee, Ripley and I found the two varieties growing under what seemed to be identical conditions, almost together but actually in little discrete colonies a few yards apart. At the time I felt satisfied that in this station at least they were self-reproductive and independent organisms, and if not mutually sterile, at least not in active genetic contact. It still seems possible that the varieties as treated here will deserve reinstatement as species, but this should be postponed until we can learn more about their behavior in nature and something of their genetic background.

Key to the Varieties of *A. sparsiflorus*

1. Leaves 2.5–10.5 cm. long, the upper ones with 9–19 mostly oblong-oblanceolate or -obovate leaflets 4–15 mm. long; *calyx* 3.2–4.3 mm. long, the tube 2–2.8 mm. long, 2–2.4 mm. in diameter, the teeth 1.2–1.7 mm. long; *banner* 6.2–8 mm. long; *pod* 1.1–2.6 cm. long, 3–5 mm. in diameter; *ovules* 10–15 286a. var. *majusculus*
1. Leaves 1.5–5 cm. long, with 9–15 broadly elliptic, obovate, or suborbicular leaflets 2–7 mm. long; *calyx* 3–3.5 mm. long, the tube 1.5–1.9 mm. long, 1.6–2 mm. in diameter, the teeth 1.5–2 mm. long; *banner* 5.5–6.6 mm. long; *pod* (5) 6–8 mm. long, 2.7–4 mm. in diameter; *ovules* 6–8 286b. var. *sparsiflorus*

286a. ASTRAGALUS SPARSIFLORUS var. MAJUSCULUS

Pubescence scanty, the hairs up to 0.5–0.7 mm. long; *peduncles* slender, 1–7.5 cm. long; *racemes* 2–10-flowered, the axis 1–4 cm. long in fruit; *banner*

Map No. 125. Top, the Colorado Rocky Mountains. Range of *A. sparsiflorus*:  var. *sparsiflorus*; and  var. *majusculus*; and of  *A. Wetherilli*. Bottom, the John Day and low Columbia Valleys, interior Oregon and Washington. Range of *A. diaphanus*.

recurved through $\pm 45^\circ$, obovate-cuneate, 6.2–8 mm. long, 3.8–5.5 mm. wide; *wings* 5.5–7 mm. long, the claws 2.1–2.5 mm., the broadly oblanceolate, obtuse, slightly and subequally incurved blades 3.8–5 mm. long, 1.4–2.2 mm. wide; *keel* 4–5 mm. long, the claws 2–2.5 mm., the half-obovate blades 2.1–3 mm. long, 1.4–2.2 mm. wide; *pod* narrowly oblanceolate in profile, gently incurved, contracted distally into a short, triangular, compressed beak, red- or purple-mottled, the septum narrow but always present, 0.2–0.6 mm. wide.—Collections: 6 (i); representative: *Eastwood* (from Denver) in 1892 (WS); *Ripley & Barneby* 10,455 (CAS, NY, RSA).

Dry gravelly banks, open hillsides and sandy canyon bottoms, sometimes on road cuttings or natural talus, in loose granitic sands or gravels, 5000–8000 feet, local, known only from the Platte River canyon on the east slope of the Front Range, from near Denver upstream to Shawnee, Denver, Douglas, and Park Counties, Colorado.—Map No. 125.—May to July.

ASTRAGALUS SPARSIFLORUS var. *MAJUSCULUS* (rather larger) Gray in Proc. Amer. Acad. 6: 206. 1864.—“With the preceding [i.e., *A. sparsiflorus*, ‘on the lower Rocky Mountains of Colorado Territory, about lat. 40° . . .’], no. 129 of the same [Hall & Harbour] collection.”—Holotypus, GH! isotypi, BM, MO, OXF, NY, P, US!

Tium variegatum (variegated, of the mottled pod) Rydb. in Bull. Torr. Club 34: 48. 1907.—“COLORADO: Platte Canon, May 19, 1894, State Agricultural College, Colorado, distribution no. 15 (type in herb. N. Y. Bot. Garden).”—Holotypus, probably collected by Crandall, NY! —*Batidophaca variegata* (Rydb.) Rydb. in N. Amer. Fl. 24: 320. 1929.

The larger phase of the Front Range milk-vetch, var. *majusculus*, is an astragalus of modest mien, resembling some small-flowered northwestern forms of *A. lentiginosus* in general appearance but differing from these in its much shorter, shallowly campanulate calyx and narrowly oblanceolate, not or scarcely inflated, brightly red-mottled pod. In most technical features it agrees with some species of sect. *Villosi* subsect. *Austro-Orientales*, a group dispersed at low elevations and in quite different environments through the southeastern United States (west to Kansas and eastern Texas), but its close relationships lie with *A. Wetherilli* of western Colorado and adjoining Utah, of which the differential characters are mentioned in the last entry, and with *A. diaphanus* of interior Oregon, which is discussed below. Although somewhat unusual among the *Inflat*i, because of its fruit at once semibilocular and little or not inflated, var. *majusculus* has no relatives among species characterized by a pod similar in exterior form and section. Thus Rydberg's ultimate transference of his *Tium variegatum*, together with *T. sparsiflorum*, to *Batidophaca*, theoretically a genus with unilocular pods, was justified in fact, if not in logic. Except for var. *sparsiflorus*, no other astragalus at all nearly resembling var. *majusculus* is known to occur along the forks of the South Platte; it should therefore be identified with ease.

286b. *ASTRAGALUS SPARSIFLORUS* var. *SPARSIFLORUS*

Pubescence sometimes more copious, always shorter than in var. *majusculus*, the hairs up to 0.2–0.5 mm. long; *racemes* (1) 2–6-flowered, the axis (0) 1.5–2.5 cm. long in fruit; *banner* recurved through 90° , 5.5–6.6 mm. long, 4.2–5 mm. wide; *wings* 5.2–5.9 mm. long, the claws 1–1.7 mm., the broadly oblanceolate or obovate, strongly but unequally incurved blades 4.2–4.5 mm. long, 1.7–2 mm. wide; *keel* 3.6–4 mm. long, the claws 1.4–1.8 mm., the nearly half-circular blades 2.3–2.6 mm. long, 1.4–1.8 mm. wide; *pod* obliquely half-obovate in profile, carinate ventrally by the concavely arched suture, openly sulcate dorsally in the lower $\frac{1}{2}$ – $\frac{2}{3}$, contracted distally into a broadly triangular, laterally flattened beak, the valves purplish-tinged or -mottled, the septum very narrow or obsolete, not over 0.2 mm. wide.—Collections: 7 (i); representative: *Brandeggee* 562 (MO, NY); *Penland* 1693 (CAS, RM); *Jones* (from below Manitou) in 1878 (NY, POM); *Ripley & Barneby* 10,454 (CAS, NY, RSA); *Ramaley* 1378 (RM).

Habitats of var. *majusculus*, 5400–8000 feet, uncommon, upper canyon of the South Platte and thence south through the foothills of Pike's Peak to the

upper Arkansas River, in Denver, Park, Teller, El Paso, and Fremont Counties, Colorado.—Map No. 125.—Late May to August.

ASTRAGALUS SPARSIFLORUS (with scattered flowers) Gray in Proc. Amer. Acad. 6: 205. 1864.—“On the lower Rocky Mountains of Colorado Territory, about lat. 40°, Hall & Harbour, no. 128.”—Holotypus, GH! isotypi, BM, K, MO, NY, P, US!—*Tragacantha sparsiflora* (Gray) O. Kze., Rev. Gen. 948. 1891. *Tium sparsiflorum* (Gray) Rydb. in Bull. Torr. Club 32: 660. 1905. *Batidophaca sparsiflora* (Gray) Rydb. in N. Amer. Fl. 24: 320. 1929.

The var. *sparsiflorus* is an extremely delicate little astragalus, remarkable for the small size of the leaflets, flowers, and fruits. Although the plants mature rapidly and ordinarily begin to bear flowers and pods within two or three months after germination of the seed, the root is potentially perennial; and even if never much thicker than a common pencil, it becomes decidedly woody in the second or third year. The pod of var. *sparsiflorus*, although so much shorter than that of var. *majusculus*, is formed after the same pattern. It is widest above the middle and then abruptly contracted into a quite similar beak which only appears more prominent because it remains unaltered while the fertile, bluntly triquetrous body is reduced in length by half.

In the Arkansas valley the Front Range milk-vetch enters the range of *A. cerussatus*, a species with flowers nearly as small and as few, but differing in its gray-villosulous herbage and much larger, bladderly-inflated pod.

287. *ASTRAGALUS DIAPHANUS*

Delicate, diffuse or prostrate, annual or biennial, with a slender or subfiliform taproot, thinly or (when young) cinereously strigulose with straight, appressed hairs up to 0.3–0.6 mm. long, the stems and often the leaflet-margins red-tinged, the herbage green or greenish, the leaflets glabrous and commonly purple-dotted above; *stems* rather few, commonly 3–10, rarely numerous, radiating from the root-crown, 4–30 (37) cm. long, simple or divaricately few-branched below the middle; *stipules* herbaceous or submembranous, green or purplish, ovate-triangular, 1.5–4 mm. long, the lowest becoming papery and brownish, $\pm$ amplexicaul-decurrent, free; *leaves* 2–5 (6) cm. long, shortly petioled, with (5) 7–13 rather distant, slenderly petiolulate, oblong-obovate, -ovate, or obovate-cuneate, obtuse, truncate, or retuse, mostly flat leaflets (2) 3–12 mm. long; *peduncles* divaricate, 1–4 (5.5) cm. long, shorter than or rarely equaling the leaf; *racemes* loosely (3) 7–15-flowered, the flowers at first ascending, later spreading and at last declined, the axis (0.4) 1–3.5 (4.5) cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 0.8–1.8 mm. long; *pedicels* at anthesis 0.6–1 mm. long, becoming arched outward, a little thickened, 1–1.8 mm. long in fruit, persistent; *bracteoles* 0; *calyx* 3.5–4.5 mm. long, strigulose with black or black and white hairs, the sub-symmetric disc 0.5–0.7 mm. deep, the tube 2–2.6 mm. long, 1.6–2.1 mm. in diameter, the lance-subulate teeth 1.3–1.9 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish with lavender-veined banner and purple-tipped keel, sometimes all suffused with pale lilac; *banner* recurved through 45°, 6.7–9.1 mm. long, the cuneate claw expanded into an ovate or oval, deeply notched blade 4.2–5.3 mm. wide; *wings* 6.1–7.9 mm. long, the claws 1.8–2.7 mm., the lunately oblanceolate or oblong-obovate, obtuse or subemarginate blades 4.4–5.6 mm. long, 1.5–2.5 mm. wide; *keel* 4.1–5.7 mm. long, the claws 1.7–2.8 mm., the broadly half-obovate or -circular blades 2.1–3.3 mm. long, 1.6–2.2 mm. wide, abruptly incurved through 110–125° to the obtuse, sometimes obscurely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* deflexed or declined, sessile, obliquely linear-oblong, oblanceolate, or half-elliptic, rarely half-ovate in profile, lunately incurved or (when long and narrow) incurved through $\frac{1}{2}$ -circle, (1) 1.5–2.8 cm. long, 3–9 mm. in diameter, somewhat turgid to distinctly inflated and almost bladderly when short and broad, obtuse at base, contracted distally into a broadly or narrowly triangular, cuspidate beak, variably compressed but usually $\pm$ triquetrous, deeply

(or when subinflated, shallowly) sulcate dorsally, the thin, purplish-green, sparsely and minutely strigulose valves becoming papery-membranous, translucent, stramineous or ultimately brownish, inflexed as an incomplete septum 0.5–1 mm. wide; *dehiscence* apical, after falling; *ovules* (6) 8–14; *seeds* brown, olivaceous- or orange-brown, sometimes purple-speckled, smooth or nearly so, dull, 1.5–2.3 mm. long.—Collections: 15 (ii); representative: *Peck* 13,754, 14,565, 14,880 (all WILLU); *Cronquist* 6435 (NY, RSA, WS); *C. L. Hitchcock* 19,235 (CAS, DAV, ID, NY, WS); *Ripley & Barneby* 6625 (CAS, RSA); *L. F. Henderson* 5373 (CAS, ORE); *Suksdorf* 7726 (NY, WS), 10,498 (WS).

In thin gravelly soil overlying basalt or on sandbars and sandy banks of intermittent streams, 150–2000 feet, uncommon but forming colonies, valley of John Day River from near Dayville, Grant County, Oregon, downstream to its confluence with the Columbia, thence west along the Columbia to The Dalles in Wasco County and on the north bank near Bingen in Klickitat County, Washington; perhaps extending just south from the John Day to the head of Silver Creek in the Harney Basin drainage (the locality "Trout Creek," *T. Howell*, requiring confirmation).—Map No. 125.—April to June.

ASTRAGALUS DIAPHANUS (translucent, of the pod) Dougl. ex Hook., Fl. Bor.-Amer. 1: 151. 1831.—"Abundant in sandy soil near the Great Falls of the Columbia."—Holotypus, from "Gravelly and rocky banks of the Columbia," K! isotypi, GH (fragm.), OXF!—*A. lentiginosus* var. *diaphanus* (Dougl.) Jones in Proc. Calif. Acad. Sci. II, 5: 675. 1895.

Astragalus drepanolobus (with sickle-shaped pod) Gray in Proc. Amer. Acad. 19: 75. 1883.—"Washington Territory [now Oregon], on John Day's River at Scott's Bridge, J. & J. T. Howell, May, 1882." Holotypus, collected May 10, 1882, GH! isotypi (mostly attributed to Thomas Howell alone), DS, G, K, MO, NY, ORE (2 sheets, 1 labeled *T. Howell* 44), P, US, WS!—*Hamosa drepanoloba* (Gray) Rydb. in Bull. Torr. Club. 54: 21. 1927.

Astragalus diurnus (diurnal, a pun on John Day) Wats. in Proc. Amer. Acad. 21: 450. 1886.—"Collected at Dayville, on John Day River, Oregon, by Thomas Howell, May, 1885."—Holotypus, dated "May 19, 1885," GH! isotypi variously labeled: ORE ("Dayville, May 19"), WS ("Trout Creek, May 18"), NY (2 sheets, as the preceding, but one with "Trout Creek" ruled out and "John Day Valley" substituted in Howell's hand), US ("John Day River, May 18")!—*Phaca diurna* (Wats.) Rydb. in N. Amer. Fl. 24: 353. 1929. *Astragalus diaphanus* var. *diurnus* (Wats.) Barneby ex Peck, Man. Ore., Ed. 2. 482. 1961.

Astragalus Craigi ("dedicated to Prof. Craig, in whose herbarium it was found") Jones in Zöe 5: 42. 1900.—"Coll by Howell on John Day's River, Or., May, 1885."—Holotypus (fragments from the Craig sheet, not located), POM! isotypi variously labeled: NY ("Dayville, May 19"), ORE ("May, 1885"), WS ("Dayville, May 19, *T. Howell* 149")!

The transparent milk-vetch, *A. diaphanus*, is a delightful little plant, commonly a fugacious annual perishing with the onset of summer heat but occasionally persisting into a second season. In its area of dispersal, where it has no close kindred, it is easily recognized by its diffuse growth-habit, its few, short and broad, rather distant, usually red-margined leaflets, and its tiny, whitish, lavender-striate flowers. The valves of the pod are extraordinarily variable in width, outline, compression, and curvature, and always so thin in texture as to reveal the 3–7 but commonly 4–5 pairs of seeds within.

Under the preceding species, *A. sparsiflorus*, I have described a racial situation peculiar in the genus in which two partly sympatric forms differ greatly from one another in length and outline of the semibilocular or, in rare cases, unilocular fruit and simultaneously in several other features, including the size of leaflets and flowers, curvature of the petals, and ovule-number. With *A. diaphanus* we have an analogous but interestingly different case in which the plant-body up to the pod remains virtually unchanged through an extraordinary series of carpological modifications. The flowers of the plants described as *A. drepanolobus*, *A. diaphanus*, *A. Craigi*, and *A. diurnus*, and so far as can be discerned all other organs up to the fruit, are essentially alike. However their pods differ so greatly in length, width (or turgidity), and development of the septum in relation to the cavity's diameter, that the extreme forms *A. drepanolobus* and *A. diurnus* were interpreted by Rydberg as representing different genera, *Hamosa* and *Phaca*, respectively. Modern collections present, nevertheless, a scarcely interrupted series connecting the long, narrow, semibilocular fruit of *A. drepanolobus*, which is incurved into the shape of a sickle, with the much shorter, obliquely ovoid, subunilocular fruit of *A. diurnus*; fruits corresponding with *A. diaphanus* sens. str. and *A. Craigi* mark shorter

and longer intermediate steps. As a by-product of the shift from long and narrow to short and wide profile, the pod's dorsal groove, at first comparatively deep and narrow (the depth increasing with the degree of curvature), becomes increasingly open and shallow and the triquetrous compression, which is so marked a feature in *A. drepanolobus*, becomes increasingly obscure. The pod of *A. diaphanus* has been described as bilocular and that of *A. diurnus* as unilocular, but in reality the width of the septum, always present at least in the pod's lower half, varies absolutely only from ± 0.5 to 1 mm.; with inflation of the cavity the septum becomes less noticeable but is always present. The variation in the fruit is at least roughly correlated with dispersal of the populations along John Day Valley, the shorter and more inflated types being confined to Grant and Wheeler Counties, whereas the narrower, longer, and more sharply trigonous ones occur at lower elevations in Sherman and Wasco Counties and across the Columbia in Klickitat County. It might be possible to recognize a var. *diurnus* (which I proposed in manuscript and which was taken up by Prof. Peck) for the plants found in the more elevated and eastern parts of the species range, but a line between this and *A. diaphanus* sens. str. (including *A. drepanolobus*) appears at present artificial and arbitrary. If the species is correctly placed in sect. *Inflati*, it is reasonable to interpret the pod of shorter and plumper outline as the more primitive type of fruit from which a pod of narrower, hamosoid profile and compression has evolved in the subdesertic climate of the Columbia Valley floor.

In general appearance and in the majority of technical features, *A. diaphanus* resembles *A. Wetherilli* closely, and if we accept the forms of it with semibilocular pods as recent derivatives of a uni- or subunilocular ancestor, there will be no difficulty about accepting the species as a member of sect. *Inflati*, even though its range lies far north of the main speciation centers of the section. Certainly it has no close kindred among astragali formerly referred to sect. *Hamosi* by Jones or the genus *Hamosa* by Rydberg. A cytological investigation of part of *Hitchcock 19,235*, (from Wheeler County, cited above) by Head (1957, p. 100) revealed an unexpected chromosome complement of $2n = 28$, a number foreign so far to sect. *Inflati*, as it is to the so-called hamosoid groups. The significance of the base-number 14 in this species cannot be estimated, until we have counts from the morphologically similar species native to the Colorado Rockies.

The type-collections of *A. diurnus* and *A. Craigi* exist as two separable sets of specimens collected ostensibly in the neighborhood of Dayville on the same day or possibly on succeeding days in May, 1885. Howell was often inaccurate or imprecise in labeling, and the isotypi must be identified as such by matching the actual specimens rather than the tickets which accompany them. The holotypus of *A. diurnus*, and the isotypus in Howell's own herbarium are dated May 19; some obvious duplicates, dated May 18, were issued with a printed label reading "Trout Creek, Blue Mountains," a stream believed to be one of the sources of Silvies River, flowing south to Harney Lake, not north to the Columbia. The Trout Creek isotypus at WS is accompanied by a manuscript note identifying the specimen as authentic *A. diurnus*; a duplicate label at NY has "Trout Creek" ruled out and "John Day Valley" substituted in Howell's hand. It seems fairly certain that the type-station of *A. diurnus* is really Dayville. The sheet of *A. Craigi* examined by Jones in Prof. Craig's herbarium has not been found, so that it seems reasonable to designate the fragments in Jones's own collection as the holotypus. These naturally lack an original Howell label, but they match very closely plants at NY, ORE (herb. Howell), obviously distinct from the similarly labeled isotypus of *A. diurnus*, and WS, collected by Howell at Dayville on May 19.

LXIX (v). Subsectio HORNIIANI

Annuals but of long duration, the stems indefinitely elongating while moisture lasts, the taproot at first slender becoming woody as the year advances, the whole plant eventually drying up and rolling away as a tumbleweed; *leaflets* 15–33; *racemes* densely 10–35-flowered, oblong-cylindric or subglobose, the small, whitish or faintly purplish flowers subsessile or shortly pediceled; *pods* crowded into dense, globose or oblong heads, subpersistent, sessile, bladdery-inflated, unilocular; *ovules* 11–14 (17).—Sp. 1, halophyte, of interior southern California (Great and San Bernardino Valleys; edge of Mohave Desert), northwestern Nevada, and coastal Baja California.

ASTRAGALUS sect. INFLATI subsect. HORNIIANI, subsect. nov., herbae annuae diu persistentes in salsis apricis obviae sero exsiccatae ventuque dispersae, quoad legumen vesicario-inflatum uniloculare, calycem campanulatum, floresque parvulos cum *Inflatis* subsect. *Aridis* congruentes, sed habitu suo, et floribus subsessilibus leguminibusque in capitulum oblongum seu subglobosum congestis (nec laxe racemosis) absimiles.—Sp. unica: *A. Hornii* Gray.

The Horn milk-vetch, for which a monotypic subsection is here proposed, was associated by Jones (1923, p. 93, in clave, p. 103) and by Rydberg (1929, p. 358) with *A. (Densifolii) pycnostachyus*, also a Californian (coastal) halophyte with dense racemes of small flowers but very different in its stout perennial root, sheathing scarious stipules, and nodding flowers. The species has much more in common with the *Inflati*, from which it stands apart by reason of its subcapitate or shortly oblong inflorescence of almost sessile flowers and more particularly by its peculiar ecology and life history. The plants are confined to saline flats and lake shores where the seeds germinate in early spring, sometimes in such quantity that the young plants form dense clover-like masses of green herbage. At first erect, and capable of bearing its first flowers when only a foot high or less, the average plant continues to vegetate over a very long period; the finally trailing stems may reach a length of 12 dm. and together form depressed entanglements up to five or six feet in diameter. Late in summer or early in fall the tissues begin to dry out, and the plant at length breaks from its now woody root and rolls away before the wind as a tumbleweed, scattering the seeds from the persistent or tardily and reluctantly deciduous fruits.

288. ASTRAGALUS HORNII

Diffuse or (when young) erect, annual but of long duration, villosulous or loosely strigulose with fine, spreading or subappressed hairs, the stems often glabrous or glabrate below, the herbage green or greenish-cinereous, the leaflets either pubescent or glabrous above; *stems* varying from quite slender to stout and fistular, stramineous or purplish, 3–12 dm. long, commonly branched or spurred at 1–several nodes preceding the first of the several or very numerous peduncles, flexuous or zigzag distally in age; *stipules* 2.5–7 mm. long, membranous or broadly membranous-margined, becoming papery and pallid in age, triangular-, lance-, or deltoid-acuminate, $\pm$ semiamplexicaul or semi-decurrent, the blades commonly deflexed; *leaves* (1.5) 2.5–13 cm. long, the lowest ones shortly petioled, the rest subsessile, with (11) 15–33 narrowly elliptic, oblong-elliptic, or -obovate, acute, obtuse and mucronulate, obtuse, or sometimes emarginate, flat or loosely folded leaflets (3) 5–23 mm. long; *peduncles* incurved-ascending or more commonly divaricate and straight, varying from much shorter to slightly longer than the leaf; *racemes* densely (8) 10–35-flowered, the flowers spreading and ascending to form subglobose or oblong heads, the axis not or little elongating, 0.7–5 cm. long in fruit; *bracts* membranous or broadly membranous-margined, ovate-triangular or lanceolate, 1.2–2 mm. long, reflexed in age; *pedicels* ascending or spreading, at anthesis 0.2–0.9 mm., in fruit 0.4–1.3 mm. long, little thickened but persistent; *bracteoles* 0, rarely a minute scale; *calyx* 3.8–6 mm. long, villosulous or loosely strigulose with white or mixed black and white hairs, the subsymmetric disc 0.5–1.1 mm. deep, the submembranous tube 2.3–4.4 mm. long, 2–2.9 mm. in diameter, the firm, subulate or triangular-subulate teeth 1–2.4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish or cream-colored, sometimes tinged with pale, dull lilac; *banner* recurved through $\pm 40^\circ$, obovate-cuneate, rhombic-elliptic, or oblanceolate, shallowly notched, 7.8–10.2 mm. long, 3.5–8 mm. wide; *wings* 7–9.8 mm. long, the claws 2.7–4.5 mm., the oblong-oblanceolate, narrowly oblong, or linear-lanceolate, obtuse or rarely (when broad) emarginate, nearly straight blades 4.5–6.8 mm. long, 1.4–3.1 mm. wide; *keel* 5.9–8.4 mm. long, the claws 3–4.5 mm., the half-obovate or almost half-circular blades 3–4.8 mm. long, 1.9–2.7 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the blunt, deltoid apex; *anthers* (0.3) 0.4–0.6 mm. long; *Pods* spreading and ascending, crowded into dense, subglobose or oblong-cylindric heads $\pm 2.5\text{--}3.5$ cm. in diameter, sessile, subpersistent or very tardily disjointing, obliquely ovoid-acuminate or inversely pyriform, bladdery-inflated, 0.9–1.8 cm. long, 5–9 mm. in diameter, rounded (and sometimes dorsally gibbous) at base, contracted distally into a triangular-acuminate, laterally flattened beak 2–9 mm. long, the ventral suture straight or nearly so, exceptionally concavely arcuate, the dorsal one gibbous-

convex, the pale green or faintly pink-tinged, variably pubescent valves becoming papery-membranous, stramineous, delicately cross-reticulate, the funicular flange 0–0.5 mm. wide; *ovules* 11–14 (17); *seeds* brown, sometimes purple-dotted, smooth but dull, 1.4–2.3 mm. long.

The Horn milk-vetch is notably discontinuous in range and quite variable in each of its several main areas of dispersal. The populations in Baja California seem to differ from the much better known ones in the north in a number of small ways, and the so-called *A. bajaensis* may reasonably be maintained as *A. Hornii* var. *minutiflorus*.

Key to the Varieties of *A. Hornii*

1. Herbage villousulous or loosely strigulose with hairs up to 0.6–0.9 mm. long; *calyx-teeth* 1.7–2.4 mm. long; *pod* (1.2–1.8 cm. long) relatively long-beaked, the beak 4–9 mm. long, the valves hirsute with horizontally spreading or widely ascending, lustrous hairs up to 1–1.6 mm. long; California and n.-w. Nevada 288a. var. *Hornii*
1. Herbage strigulose, often quite thinly so, with hairs up to 0.3–0.5 mm. long; *calyx-teeth* 1–1.5 (1.7) mm. long; *pod* (0.9–1.7 cm. long) short-beaked, the beak 2–5 mm. long, the valves strigulose with narrowly ascending or subappressed hairs up to 0.4–0.7 mm. long or glabrate in age; Baja California 288b. var. *minutiflorus*

288a. *ASTRAGALUS HORNII* var. *HORNII*

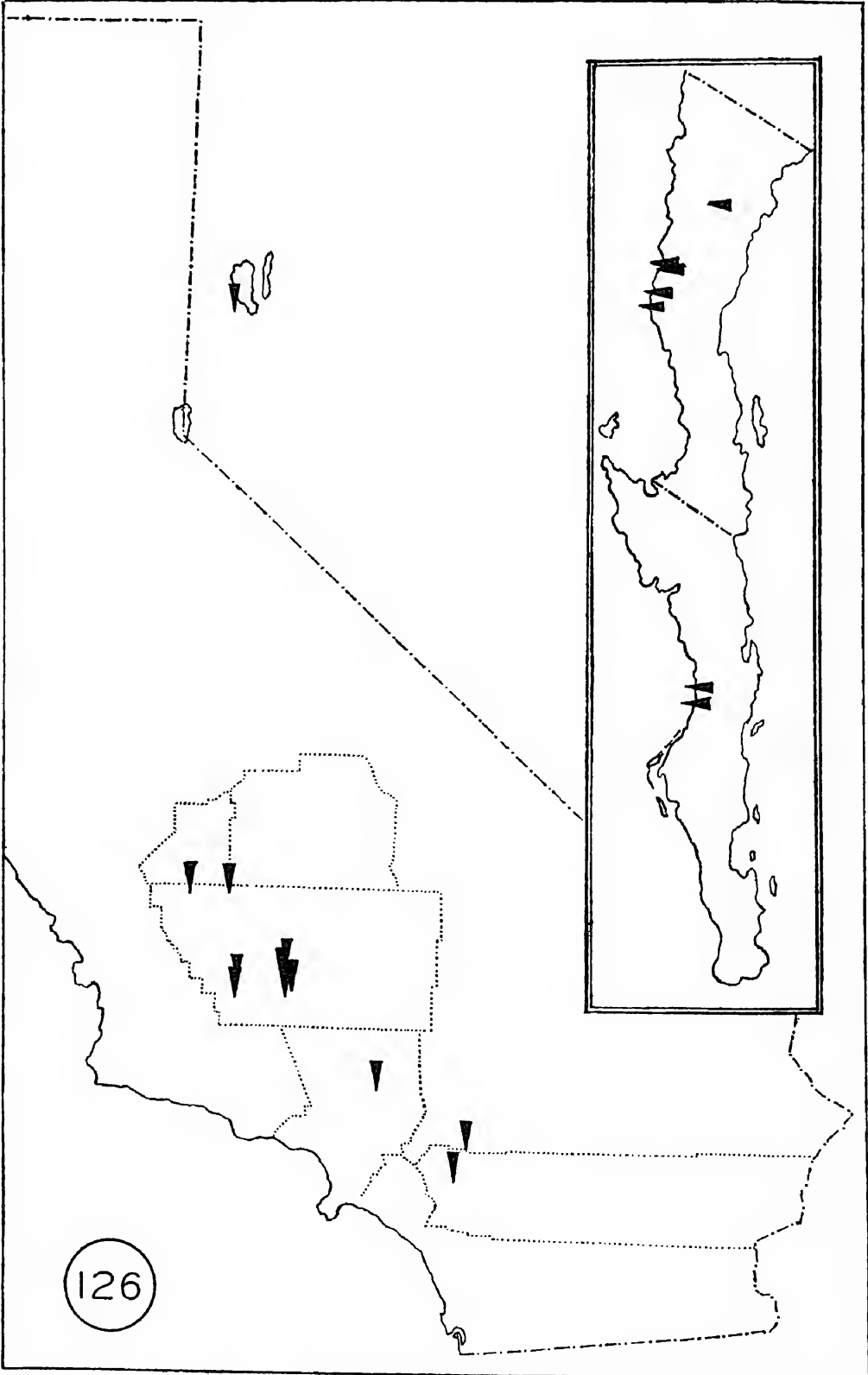
Vesture of the herbage variable in density and orientation, the hairs spreading or subappressed, the leaflets either pubescent on both sides or glabrous above; *stems* 3–12 dm. long; *leaflets* variable in number and shape, (11) 15–31, narrowly elliptic to oblong-obovate, acute or emarginate; *peduncles* 2–15 cm. long, either much shorter or a little longer than the leaf; *racemes* (10) 15–35-flowered. —Collections: 17 (i); representative: *Eastwood & Howell 4033* (CAS, NY); *Ripley & Barneby 7031* (CAS, NY, RSA); *Hoffman* (from Harold) in 1932 (SBM); *Twisselmann 1515* (CAS); *Parish 4182* (NY); *Kennedy 1971* (NA).

Alkaline flats, plains, and lake shores, in stiff clay soils moist in spring and hard-baked in summer, sometimes along irrigating ditches, with salt-grass, *Che-nopodiaceae*, and other halophytes, formerly abundant (but now relatively scarce and scattered) at 190–450 feet over the floor of the upper San Joaquin Valley in Kern, Tulare, and southern Kings Counties, California; isolated on dry playas at about 2700 feet along the edge of the Mohave Desert in Los Angeles County (near Harold) and formerly (extinct for over 40 years) in San Bernardino Valley (near Riverside and San Bernardino); remotely isolated at about 3900 feet on the west shore of Pyramid Lake, Washoe County, Nevada.—Map No. 126.—April to September (November).

ASTRAGALUS HORNII (Dr. George Henry Horn, entomologist, collected in California in 1862–4) Gray in Proc. Amer. Acad. 7: 398. 1868.—“Near Fort Tejon, or in Owen’s Valley, Tulare Co., in S. E. California, Dr. G. H. Horn, 1863.”—Holotypus, doubtless from Fort Tejon, Kern County, GH!—*Tragacantha Hornii* (Gray) O. Kze., Rev. Gen. 945. 1891. *Phaca Hornii* (Gray) Rydb. in N. Amer. Fl. 24: 358. 1929.

Phaca tularensis (of Tulare Lake) Rydb. in N. Amer. Fl. 24: 358. 1929.—“Type collected near Tulare Lake, southern California, Lemmon (Gray Herb.).”—Holotypus, GH! isotypus (fragment), NY!—*A. Hornii* var. *tularensis* (Rydb.) Jeps., Fl. Calif. 2: 354. 1936. *A. tularensis* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937.

In San Joaquin Valley the Horn milk-vetch is remarkably variable as to pubescence, shape and number of leaflets, and length of peduncles. Jepson maintained *Phaca tularensis* as a variety marked by relatively few, densely hairy leaflets combined with short peduncles and small, little swollen, somewhat incurved pods; but I feel satisfied that the typus is no more than one of several minor variants. Certainly the size of the pod is not correlated with any other character. Within a radius of fifteen miles of Bakersfield there are (or have been) found individual plants with rather few, narrow, acute, and densely villous leaflets combined with long peduncles, and other plants with many broad, emarginate, thinly strigulose leaflets combined with peduncles either longer or shorter than the leaf. The possibilities for variation in leaflet number in the species sens. lat. is illustrated by an isotypus of var. *minutiflorus* at CAS, of which one stem



bears 15–19, the other up to 31 leaflets to the leaf. The populations at Pyramid Lake in Nevada and at the edge of the Mohave Desert are, so far as I know them, monomorphic and of the *tularensis* type as originally defined. Probably, however, these are recent introductions from the true home of the species in the San Joaquin Valley. Tulare Lake, especially before the advent of irrigation and agriculture, was an important halt on the flyway of migrating waterfowl, and seeds of *A. Hornii*, which grows best in ground moist or inundated in spring, might easily be transported to other lake shores and there give rise to a self-perpetuating colony. If such were the case, I should expect the daughter colonies to possess only a small part of the genetic potential present in the whole species, to be in effect pure strains isolated by circumstance.

Due to its prolonged life span and eventually unwieldy stature, the Horn milk-vetch is not readily recognized as annual from herbarium specimens. It is easily distinguished, however, from all *Inflati* whether annual or perennial by its headlike or densely spiciform racemes of subsessile flowers and by the strongly oblique, lustrously hirsute pods likewise aggregated into headlike clusters and enclosing, as a rule, only six or seven pairs of small, brown seeds. The development of the plant into a late summer tumbleweed was first noted by E. Roy Weston in a letter to Miss Eastwood (south of Bakersfield, in 1928, CAS).

A report of the Horn milk-vetch from southern Utah (Tidestrom, 1925, p. 324) was based on a specimen of Dr. Palmer's labeled "St. George, Utah, 1879" (US). The established range of the species is so discontinuous and erratic that a locality in Utah cannot be discounted out of hand. However the species has not been seen since in the Virgin Valley, and Palmer's labels cannot always be relied upon, so it seems best for the present to omit the record from the map.

288b. ASTRAGALUS HORNII var. MINUTIFLORUS

Thinly strigulose, the herbage deep green, rarely subcinereous, the leaflets glabrous above; *stems* (2) 3–6 dm. long; *leaflets* 13–33, oblong-obovate, -oblanceolate, or lance-elliptic, rarely narrowly oblanceolate, mostly emarginate; *peduncles* (2) 3.5–14 cm. long, much shorter to longer than the leaf; *racemes* (8) 10–20-flowered, the axis 1–3.5 cm. long in fruit.—Collections: 8 (i); representative; Palmer 646 (NY, P); Orcutt 1324 (GH, NY, UC); Harbison & Higgins (from Colonia Guerrero) in 1953 (RSA); Wiggins 9179 (DS); Ripley & Barneby (from San Quintín) in 1936 (K).

Saline and alkaline flats behind barrier beaches and around salt water lagoons along the Pacific Coast of Baja California, south to lat. $\pm 25^{\circ} 30' N.$; also about springs, at 3500 feet, at the northwest end of Sierra Pedro Mártir (Los Pozos).—Map No. 126.—November to June, perhaps intermittently throughout the year.

ASTRAGALUS HORNII var. MINUTIFLORUS (tiny-flowered) Jones in Proc. Calif. Acad. Sci. II, 5: 677. 1895.—"San Jorge, Lower California, Brandegee, March 17, 1889.—Holotypus, CAS! isotypi, POM (fragm.), UC!

Astragalus bajaënsis (of Baja California) Sheld. in Minn. Bot. Stud. 1: 169. 1894.—"Collected near San Gregorio [err. "Gregano"], Lower California, February, 1879, by Mr. T. S. Brandegee."—Holotypus, collected February 7, 1889, MINN! isotypi, CAS, POM (fragm.), UC!—*A. miserandus* (lamentable, apparently in reference to the epithet *bajaënsis*) Greene in Erythea 3: 76. 1895, a pedantic and illegitimate substitute. *A. Hornii* var. *bajaënsis* (Sheld.) Jones, Contrib. West. Bot. 10: 62. 1902 ("Bahaeensis"). *Phaca bajaënsis* (Sheld.) Rydb. in N. Amer. Fl. 24: 358. 1929.

Despite the epithet *minutiflorus*, the flowers of the Baja California milk-vetch are no smaller than those of var. *Hornii* and differ only slightly in the prevailingly shorter calyx-teeth. Rydberg contrasted the retuse leaflets of *Phaca bajaënsis* with the merely obtuse ones of *P. Hornii*, but there are now examples of characteristic var. *Hornii* with strongly emarginate leaflets. The short-beaked, shortly pubescent pod of var. *minutiflorus* seems to provide the best differential characters. Two minor variants deserve a word of notice. Brandegee's material from San Telmo (UC) has comparatively densely pubescent foliage and narrower leaflets than in other known populations of the variety; it may show the effect of a desiccating habitat. A remarkable plant collected by Wiggins near a spring at the north end of Sierra San Pedro Mártir has relatively loose fruiting racemes, in which the pods are well separated each from its neighbor rather than congested into a close head as is ordinarily characteristic of the species. It may represent an undescribed variety (Wiggins 9179, DS).

Map No. 126. Parts of California and northwestern Nevada; inset, Lower California. Range of *A. Hornii*:  var. *Hornii*; and  var. *minutiflorus*.

LXX. Sectio DIPHYSI

Caulescent perennials, often of rapid growth and short duration, sometimes monocarpic; *root-crown* superficial, or subterranean in 1 rare sp.; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with (7) 9–27 (29) leaflets; *flowers* small or of moderate size (the banner 7.5–21.5 mm. long), subumbellately, loosely, or remotely racemose, ascending at anthesis, the axis not or greatly elongating; *pedicels* persistent; *calyx-tube* campanulate or cylindric, ruptured, marcescent; *petals* white (with maculate keel-tip), lilac, or bright purple, rarely ochroleucous or yellowish, regularly graduated, or the keel sometimes prominent and almost equaling the banner or shortly surpassing the wings; *pod* ascending, spreading, or (especially when strongly incurved) declined, sessile, deciduous, extremely variable in size, outline, texture, and compression, varying from greatly inflated and $\pm$ didymous to narrowly lanceolate in profile and then terete to didymous or triangular-obcordate (or transversely oblong) in section, uni- or more commonly bilocular, the valves varying from papery-membranous and transparent to stiffly leathery and opaque; *dehiscence* apical, after falling (rarely also basal); *ovules* 10–42. —Spp. 3, xerophytes (rarely halophytes of soils moist in spring), 1 rare, monomorphic cryptophyte, 1 polymorphic and composed of 2 vars., 1 (*A. lentiginosus*), an enormous polymorphic aggregate of 36 vars., the first 2 of Nevada and adjoining states, the third widely dispersed in western United States and interior Washington to the South Coast Ranges and deserts of California, east to southwestern Montana, southern Wyoming, western Colorado, and the Rio Grande Valley in New Mexico, north just into British Columbia, south just into northwestern Mexico.

ASTRAGALUS sect. DIPHYSI Gray in Proc. Amer. Acad. 6: 192. 1864.—Sp. typica: *A. diphyus* Gray = *A. lentiginosus* var. *diphyus* (Gray) Jones.—*Astragalus* sect. *Lentiginosus* Sheld. in Minn. Bot. Stud. 1: 168. 1894, technically a nom. nud. but in the context an evident substitute for the preceding. *A.* subgen. *Diphyus* Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Utah & Nev.): 315. 1925, technically a nom. nov. but clearly based on sect. *Diphyisi* Gray. *A.* sect. *Diplocystium* Barneby in Proc. Calif. Acad. Sci. IV, 25: 166. 1944, a deliberate but illegitimate substitute.

Cystium sensu Rydb. in Bull. Torr. Club 32: 659. 1905 & in N. Amer. Fl. 24: 405–415 (praeter typum & sect. *Platytopia*). 1929.—Non *Cystium* Stev., 1856, based on *A. Cicer* L., nec *A.* subgen. *Cercidothrix* sect. *Cystium* Bge., 1868, based on *A. physodes* Pall.

Cystium sect. *Coulteriana* Rydb. in N. Amer. Fl. 24: 405. in clave. 1929.—Sp. typica: *C. Coulteri* (Bth.) Rydb. = *A. lentiginosus* var. *borreganus* Jones.

Cystium sect. *Lentiginosa* Rydb., l.c. in clave. 1929.—Sp. typica: *C. lentiginosum* (Dougl.) Rydb. = *A. lentiginosus* Dougl.

Cystium sect. *Diphyia* Rydb., l.c. in clave. 1929.—Sp. typica: *C. diphysum* (Gray) Rydb. = *A. lentiginosus* var. *diphyus* (Gray) Jones.

Tium sect. *Palantia* Rydb. in N. Amer. Fl. 24: 397. 1929.—Sp. typica: *T. palans* (Jones) Rydb. = *A. lentiginosus* var. *palans* (Jones) Jones.

Xylophacos sect. *Iodanthi* Rydb. in N. Amer. Fl. 24: 292. 1929.—Sp. typica: *X. iodanthus* (Wats.) Rydb. = *A. iodanthus* Wats.

The section *Diphyisi* was established by Gray to accommodate three species characterized by a greatly inflated bilocular pod of thin texture, *A. lentiginosus*, *A. diphyus*, and *A. Fremontii*, now interpreted as varieties of the protean *A. lentiginosus*. As systematic exploration of the intermountain region proceeded, the geographical and morphological gaps between the types known to Gray began to be filled in. By 1895 Jones had assembled evidence which justified the reduction of the now much more numerous *Diphyisi* to twelve varieties dispersed among the three species *A. lentiginosus* (including *A. diphyus*), *A. Coulteri* (including *A. Fremontii*), and the apparently aberrant *A. palans*. With the passage of time the distinctions between even these three broke down, and Jones in his summary Revision (1923, p. 123) reduced the section to a single species of eighteen varieties and appended this to the large and heterogeneous sect. *Inflatii*. A further step in elaboration of the group was taken by Rydberg (1929), who transferred all of the known forms to the genus *Cystium* and recognized, in the place of Jones's *A. lentiginosus*, no less than three sections in this genus and over thirty independent species.

More recently I (Barneby, 1945) returned to Jones's concept of a multiracial *A. lentiginosus*, recognizing forty (in these pages reduced to thirty-six) varieties. The accounts of sect. *Diphyis* up to the present have been those of the *A. lentiginosus* complex, but the section is expanded here to include *A. iodanthus* and its rare satellite *A. pseudiodanthus*. This pair of species possesses no character which cannot be matched somewhere in *A. lentiginosus*, and *A. iodanthus* so closely resembles some sympatric forms of its relative that fruiting material is required for certain identification. In the monographs of Jones and Rydberg *A. iodanthus* appears as a member of sect. *Argophylli* or the genus *Xylophacos*, and its pod is therefore assumed to be unilocular, which is only sometimes true.

The affinities of sect. *Diphyis* lie clearly with sect. *Inflat*i, as Jones's arrangement suggests; no exact dividing line can be drawn between the two groups. The pod of the majority of genuine *Inflat*i is strictly unilocular, whereas that of *A. lentiginosus* is (with rare exceptions) fully bilocular. There are, however, a few *Inflat*i (e.g., *A. Geyeri* var. *triquetrus*; *A. diaphanus*) with a fairly well-developed septum, and others (e.g., *A. aridus*; *A. sparsiflorus*) with only moderately or scarcely swollen pods. The introduction to sect. *Diphyis* of *A. iodanthus* and *A. pseudiodanthus*, in which the uninflated pod is either uni- or at best semibilocular, removes the only objection on carpological grounds to the amalgamation of the two sections. If we look further, however, we find that the flower of the *Inflat*i is almost always very short, with a shallowly campanulate calyx-tube and strongly curved banner and keel, whereas that of the *Diphyis* is proportionately longer, narrower, and less strongly incurved. The differences in the flower are much more easily observed than described; no formula has been found which will separate all *Inflat*i from all *Diphyis* on the basis of floral differences. It remains pretty clear, however, that the species of each group that are technically similar in pod characters are not closely similar in other respects and not closely related. When the pod of the *Inflat*i becomes little swollen or semibilocular, it retains the papery or papery-membranous texture of the section; in the uni- or subunilocular, little inflated or uninflated *Diphyis*, the pod is fleshy when first formed and becomes leathery or stiffly papery in age.

Key to the Species of sect. DIPHYSI

1. Plants of Nevada, closely adjoining California, s.-e. Oregon, and s.-w. Idaho, with pod narrowly lanceolate or lance-elliptic in profile, never inflated, uni- or semibilocular, the septum not over 1.5 mm. wide, the compression of the body (below the beak) trigonous or obcompressed-trigonous and the section varying from obcordate to transversely oblong (2)
2. Root-crown and caudex (when present) superficial; *stems* and leaves ordinarily strigulose, exceptionally villosulous, but the longest hairs not over 0.3–0.7 mm. long; *pod* strigulose; relatively common, in various habitats but not on dunes, centr. Nevada n.-ward into adjoining states 290. *A. iodanthus*
2. Root-crown subterranean; *stems* and herbage villous with hairs up to 1–1.2 mm. long; *pod* villosulous; rare and local in n. Nye County, Nevada, and near Mono Lake, Mono County, California 291. *A. pseudiodanthus*
1. Plants of the same range, also extending far beyond it (range of the section), with pod greatly to not at all inflated, but always greatly swollen and fully bilocular (with septum at least 2 mm. wide) in the range of the preceding, and the section there $\pm$ terete with constrictions at one or both sutures.—Pod extremely variable in size, texture, and compression, but trigonous only rarely in one var. (var. *palans*) of the Colorado Basin, mostly ovoid or inversely pear-shaped, in some forms lanceolate or narrowly elliptic in profile but then commonly terete or nearly so 289. *A. lentiginosus*

289. ASTRAGALUS LENTIGINOSUS

Annual or more often biennial or perennial herb, diverse of aspect and extremely variable in stature and in amount, orientation, and distribution of the vesture, the herbage green, cinereous, or silvery-silky, more rarely tomentose; *stems* (solitary) few to numerous from the crown of a taproot or shortly forking caudex, simple or branched, prostrate, incurved-ascending or erect, mostly 1–10 dm. long; *stipules* semi- to almost fully amplexicaul-decurrent, free; *leaves* 1–17 cm. long, with 11–27 (29), or in some early leaves or in some seedling plants only 7–13 leaflets; *peduncles* much shorter or about as long as the leaves; *racemes* (3) 5–35 (48)-flowered, subumbellate or loosely racemose, the flowers ascending or spreading in age, the axis not or greatly elongating; *pedicels* ascending, the fertile

ones little or sometimes considerably thickened, persistent in fruit; *bracteoles* usually 0, or minute when present; *calyx* 3.8–12.5 mm. long, the tube cylindric, deeply campanulate, or campanulate, the teeth usually much shorter, subulate or triangular, the whole becoming papery, ruptured, marcescent; *banner* recurved through $\pm 30\text{--}50^\circ$, 7.4–21.4 mm. long; *wings* usually a little shorter, the blades narrowly lanceolate to linear-oblong, straight or gently incurved distally, obtuse; *keel* (shorter or rarely a little longer than the wings) 6–16.4 mm. long, the half-obovate blades incurved through (50) $80\text{--}90^\circ$ to the rounded apex; *pod* ascending (often humistrate), or spreading and incurved, sessile on the flat or obconic receptacle, readily deciduous when ripe, greatly variable as to length, outline, inflation, and texture, most commonly differentiated into an ovoid or globose, bladderly-inflated, ventrally and often also dorsally open-sulcate body and a deltoid or triangular-acuminate, laterally compressed, more or less incurved (in one var. decurved, in another tubular-filiform) beak, but sometimes lanceolate in outline and then often crescentically or even hamately incurved and little or not inflated, the leathery, papery, or papery-membranous, glabrous or variously pubescent valves inflexed (below the usually unilocular beak) as a complete or rarely incomplete septum, the funicular flange either conspicuous or subobsolete; *dehiscence* apical, through the gaping beak, after falling; *ovules* 10–42; *seeds* brown, olivaceous, orange-brown, brown dotted with purple, or purplish-black, smooth, sparsely pitted, or rarely wrinkled, dull or exceptionally sublustrous, (1.5) 1.8–3.3 (4) mm. long.

The freckled milk-vetch, *A. lentiginosus*, is hardly a species in any conventional sense of the term. As circumscribed here, it is an excessively polymorphic complex which embraces a range of variation far greater than can appear reasonable at first sight and which becomes, even when accepted on reflection as taxonomically unavoidable, as unwieldy in the mass as it is intricate in internal structure. The foregoing description, which serves merely to list the characters common to the constituent parts of the complex and to give some indication of maximum metric variations, is not much more than an abstract formula.

The incalculable number of populations which go to make up *A. lentiginosus* are dispersed over a great part of the Columbia and Great Basins, the Colorado Plateau, and the deserts of southeastern California and Arizona, whence they extend a short way into northern Mexico. Most plentiful at middle elevations and almost ubiquitous in the sagebrush climax of the Great Basin proper, the freckled milk-vetch ranges from alpine crests above the limit of trees down to desert dunes at sea level or below it. Some specialized forms have become adapted to the beds of alkaline clay sinks which are moist during the spring months, while others have passed west across the Sierra to establish outposts in the new climatic and floristic provinces of the Great Valley and South Coast Ranges in California. As pointed out in a preliminary study of the group (Barneby, 1945), most of the forms of *A. lentiginosus* fall rather readily into three categories defined, with often natural-seeming results, in terms of growth-habit, flower-size, petal-color, and raceme-length; and these categories correspond rather closely with sections in the genus *Cystium* established by Rydberg. The first group, characterized by diffuse or prostrate stems and small, usually whitish flowers arranged in short racemes not elongating in fruit, is typified by *A. lentiginosus* sens. str. and by the vars. *salinus* and *ineptus*, and includes the more specialized and local vars. *sierrae*, *antonius*, and *albifolius*, the last an obligate halophyte. The second group of forms, similar in growth-habit, but characterized by larger, commonly purple flowers, which give rise to pods often of thicker texture, is gathered around a nucleus of vars. *diphysus* and *araneosus* and likewise includes comparatively rare and localized or ecologically specialized forms, such as vars. *latus* and *toyabensis* or the halophytic var. *sesquimetralis*. The third group has flowers of moderate or rather large size arranged in much looser racemes, which elongate and early surpass the subtending leaf. They are comparatively coarse plants, with stems either erect or diffuse but most often bushily clumped, commonly purple petals, and thin-textured fruits; the vars. *coachellae*, *yuccanus*, *australis*, and *nigricalycis* are representative members. These idealized groupings, to which the many important exceptions have not yet been mentioned, are to some degree climatically segregated. The last-mentioned series is proper to desert or near-desert climates at low elevations; the plants are of rapid growth and reach maturity early, sometimes becoming biennial, monocarpic, or even truly annual. Of the groups with compact racemes the first, with small whitish flowers,

is mostly northern or becomes montane southward from about the 40th Parallel. The second, with larger, purple flowers, prevails at middle elevations from central Nevada southward. The taxonomy of the complex would be considerably simplified if we could accept these three groups as species, or even as primary subspecific divisions of one. However, even though the majority of freckled milk-vetches can be classified in this way, the resulting arrangement is not natural; moreover, there are many transitional forms which connect the idealized groupings. The var. *Fremontii* intergrades, on one hand, with var. *variabilis* of the desert group and, on the other, with var. *macrolobus* of the northern one. The var. *platyphyllidius* most closely resembles var. *salinus* of the northern group, of which it has the white flowers, but the flower-size and leathery pod are proper to the group typified by var. *diphysus*. The var. *idriensis* would fall technically into the *diphysus* group and thereby become far separated from its one very near relative var. *sierrae*. The same type of modification seems to have occurred several times in different branches of the evolutionary tree, leaving an apparently or perhaps sometimes truly reticulate pattern of relationships. The varieties cannot therefore even be arranged in a sequence that is at the same time logical in terms of the morphology and phylogenetically natural.

By an altogether different criterion, the varieties of *A. lentiginosus* might be divided into two groups of another order. The majority of them, as defined in these pages, consist of an indefinite number of populations which are associated together around an artificially conceived norm or nucleus for taxonomic purposes. The descriptions have been drawn up to cover not only the norm itself but as many of the peripheral populations as possible, and many of these are in one character or another transitional toward a second, usually vicariant variety of the same type. The varieties of this nature form a sort of jigsaw puzzle, of which each piece can be considered as a separate entity but actually hooks on, at least on one side and often on several sides, to adjoining pieces of an uninterrupted fabric. The freckled milk-vetches native to valley or low desert habitats, where the maximum dispersal is delimited less by physiographic barriers than by climatic or edaphic ones, are nearly all of this sort. The second category of varieties consists of those which are highly and more or less sharply localized, either by adaptation to a specialized habitat (as the halophytic vars. *albifolius* and *sesquimertalis*) or by physical isolation (as shown by the insular-montane endemic vars. *sierrae*, *antonius*, and *latus*). Generally, the members of this second group do not differ from their nearest relative to any greater degree than do the idealized nuclei of those which form the first. There is, however, a sharply definite, even though extremely narrow morphological discontinuity between them corresponding with the discontinuity in dispersal. It would be convenient if we could distinguish between these two sorts of varieties in nomenclatural terms, but no means of doing so has been devised. A few of the more sharply differentiated forms of *A. lentiginosus* have been accepted in modern floristic works as species apart, but none of them possess more than a single truly differential character (e.g., the yellowish petals of var. *nigricalycis*, the filiform pod-beak of var. *kernensis*, etc.) separating them from the central core of *A. lentiginosus*. Their removal from the complex does somewhat reduce its unwieldy mass, but in the process they assume an importance and distinction which are not rightly theirs. However untidy or impractical the inclusive concept of *A. lentiginosus* may appear, it is one which is forced upon the unhappy taxonomist by the logic of facts. Perhaps only a botanist long familiar with the situation as it unfolds in the field can appreciate the complexity of the dilemma.

The remarks up to this point apply principally to the forms of *A. lentiginosus* in which the pod is moderately to greatly inflated, with a globose or ovoid body contracted into a triangular beak. Although the pod varies enormously, both within and between populations, not only in size but also in texture and curvature, it is in all these forms of the same basic design, recognizable at a glance as belonging to the freckled milk-vetch. In a small group of forms of which vars. *palans*, *Wilsonii*, and *borreganus* are typical, the pod is scarcely or not at all inflated, becoming linear-lanceolate in profile; and to the novice meeting these varieties for the first time, they seem to stand well outside the legitimate orbit of *A. lentiginosus*. Rydberg, in fact, went so far as to refer them to a separate genus; but as experience and material accumulate, the genuine affinities, first perceived by Jones, make themselves felt through those individual plants which bear very slightly, then appreciably, then markedly swollen fruits without any perceptible accompanying alteration in the plant-body or in detail of the flower. All of the uninflated types (with the exception of var. *maricopae*, more recently discovered) were described upon discovery as species apart from *A. lentiginosus*; it would certainly simplify the taxonomy somewhat, if we could maintain them as such. However a classification which can be defended only for its convenience makes no very strong appeal to the imagination.

The following account of *A. lentiginosus* follows in most details the preliminary revision (Barneby, 1945). Persons who are interested in some historical aspects of the species and synonyms merely listed but not otherwise mentioned in the following pages, are urged to look back into this dated and in some respects naive paper. Several forms of *A. lentiginosus*

are known to be locoweeds, but they are not readily eaten by stock except in years of unusual drought and are not abundant in the principal summer grazing lands of the western mountains. The following key to the varieties requires material with fruit sufficiently formed to show the size and texture at maturity and at least enough fragments of flowers to demonstrate the length of the keel and the color of the petals. Without one or more of these essentials, a given specimen may often be named successfully by means of the maps and descriptions. The high percentage of plants transitional between two varieties makes it impossible to construct a really efficient key; which would have to be extended and refined in order to deal with a countless throng of individual variants.

Key to the Varieties of *A. lentiginosus*

1. Pod $\pm$ strongly inflated, the body globose or ovoid, either at least 7 mm. in diameter, or at least half as broad as long (2)
2. Racemes in fruit short and compact, the axis not over 4 (5) cm. long (3)
3. Flowers comparatively small, the keel 6–8.5 (9) mm. long (4)
4. Plants of the Great and Columbia Basins, n.-e. California to s. British Columbia, extreme s.-w. Montana, Nevada n. and e. of Lake Tahoe, and w. Utah (5)
5. Pod thinly papery, commonly transparent or translucent (6)
6. Leaves and stems subglabrous to densely strigulose, but the vesture appressed or nearly so (7)
7. Raceme comparatively loose, not cylindric or globose in fruit; *stems* mostly simple, 1–3 dm. long; widespread 289c. var. *salinus* (p. 919)
7. Raceme dense, cylindric or globose in fruit; *stems* branching below the middle, mostly 2.5–5 dm. long; n.-w. Nevada and adjoining California and Oregon 289d. var. *floribundus* (p. 921)
6. Leaves and stems $\pm$ villousulous with spreading or sinuous hairs; n. Nevada, s.-e. Oregon, and adjoining Idaho 289e. var. *macrolobus* (p. 922)
5. Pod stiffly papery, opaque or nearly so (8)
8. Pod pubescent; British Columbia to n.-e. California and s. Idaho 289a. var. *lentiginosus* (p. 916)
8. Pod glabrous; mountains of e. Nevada and extreme w. Utah 289b. var. *scorpionis* (p. 919)
4. Plants of e.-centr. and s.-e. California (Sierra Nevada s.-ward from Lake Tahoe; White and Inyo Mountains; San Bernardino and San Gabriel Mountains) and of s.-w. Nevada (White and Charleston Mountains) (9)
9. Beak of the pod tubular, linear in profile, resembling a persistent style; rare and bicentric, in s. Sierra Nevada, California, and on Charleston Peak, Nevada 289l. var. *kernensis* (p. 929)
9. Beak of the pod deltoid or triangular in profile (10)
10. Plants of alkaline flats at the e. foot of the Sierra Nevada from Inyo s. to Los Angeles County; *beak* of the pod declined; *stems* elongate, mostly 3–10 dm. long 289j. var. *albifolius* (p. 927)
10. Plants of mountain slopes and flats; *beak* of the pod erect or more commonly incurved; *stems* mostly shorter, 0.5–3.5, commonly less than 3 dm. long (11)
11. Sierra Nevada and the White and Inyo Mountains (12)
12. Leaflets 15–21, crowded, the whole leaf 1.5–5.5 cm. long; *pubescence* typically loose, villousulous; Sierra Nevada 289f. var. *ineptus* (p. 923)
12. Leaflets 17–27, distant, the whole leaf 4–9 cm. long; *pubescence* appressed; White and Inyo Mountains 289g. var. *semotus* (p. 925)
11. San Gabriel and San Bernardino Mountains (13)
13. Banner 9–10.5 mm. long; *leaves* silvery-cinereous; San Gabriel Mountains 289i. var. *antonius* (p. 926)
13. Banner 10.5–14.5 mm. long; *leaves* green or subcinereous; San Bernardino Mountains 289h. var. *sierrae* (p. 925)
3. Flowers larger, the keel (8.5) 9–16.5 mm. long (14)
14. Plants of California (South Coast Ranges and San Bernardino Mountains) (15)
15. Plants of the South Coast Ranges (Mt. Hamilton to Mt. Piños); *pod* leathery or very firmly papery 289p. var. *idriensis* (p. 935)
15. Plants of the San Bernardino Mountains; *pod* papery 289h. var. *sierrae* (p. 925)
14. Plants extra-Californian (16)

16. Petals white (the keel-tip sometimes maculate); e. Oregon to s. Wyoming, n.-e. California, and extreme n. Utah and n.-w. Colorado 289m. var. *platyphyllidius* (p. 930)
16. Petals purple (17)
 17. Plants of moist alkaline flats in w. Nevada (probably Esmeralda County); *stems* prostrate, creeping, 6–8 dm. long or longer 289k. var. *sesquimetralis* (p. 928)
 17. Plants of less specialized, always dry habitats; *stems* shorter, rarely prostrate (18)
 18. Plants of the North Rim and north wall of the Grand Canyon, Coconino County, Arizona; *stems* prostrate or diffuse; *calyx-teeth* mostly 3–5 mm. long 289q. var. *oropedii* (p. 936)
 18. Plants of other range, if of n. Arizona the *stems* incurved-ascending and the *calyx-teeth* shorter (19)
 19. Pod subglobose, shortly beaked, the septum produced into the tip of the beak; rare in the limestone mountains of e.-centr. Nevada 289o. var. *latus* (p. 933)
 19. Pod mostly ovoid-acuminate, contracted distally into a well-defined, triangular or deltoid, unilocular beak; widespread (20)
 20. Pod thinly papery, 13–20-ovulate; montane plants of the mountains of centr. Nevada, mostly 8000–11,000 ft. altitude 289n. var. *toyabensis* (p. 932)
 20. Pod stiffly papery or leathery (leathery in Nevada), 24–38-ovulate; plants of middle elevations, in Nevada below 7000 ft. altitude (21)
 21. Leaflets 9–15; *peduncles* 1–2 cm. long; local in Sanpete County, Utah 289r. var. *chartaceus* (p. 938)
 21. Leaflets 15–23; *peduncles* mostly 2.5–8.5 cm. long; widespread (22)
 22. Pod typically very strongly incurved, the lance-acuminate or at least relatively narrow beak 6–15 mm. long; Utah w. of the Wasatch and Nevada 289s. var. *araneosus* (p. 938)
 22. Pod typically little incurved, the broadly triangular or deltoid beak 3–10 mm. long; n. Arizona to centr. New Mexico, extreme s.-w. Colorado, and s.-e. Utah 289t. var. *diphyssus* (p. 939)
 2. Racemes in fruit (and often in early anthesis) lax and open, becoming 4–18 cm. long or longer (23)
 23. Flower small, the keel 5.5–8.5 mm. long (24)
 24. Petals purple 289z. var. *Fremontii* (p. 945)
 24. Petals white or whitish; cf. d. var. *floribundus* and e. var. *macrolobus*, of n. Nevada and adjoining states.
 23. Flower larger, the keel over (8.5) 9 mm. long (25)
 25. Pod firmly papery or almost leathery, glabrous or minutely puberulent; n.-w. Arizona (Mohave County), local 289y. var. *ambiguus* (p. 945)
 25. Pod either papery-membranous or, if at all firm and leathery then densely pubescent and the range otherwise (26)
 26. Petals ochroleucous or whitish, with no trace of purple (except a faint purple spot on keel-tip) (27)
 27. Plants of San Joaquin Valley and adjoining Coast Ranges, California; *petals* well graduated; *pod* villosulous 289zc. var. *nigricalycis* (p. 949)
 27. Plants of w.-centr. and s.-centr. Arizona; *petals* poorly graduated; *pod* glabrous or minutely strigulose 289v. var. *yuccanus* (p. 942)
 26. Petals purple (28)
 28. Plants of the California deserts (Inyo, San Bernardino, and Riverside Counties) (29)
 29. Herbage silvery- or satiny-canescens (30)
 30. Calyx-teeth 1.4–2.9 mm. long; local, either in Coachella Valley, or in Inyo County, but not in the intervening Mohave Desert (31)
 31. Longest hairs up to 0.7–1.2 mm. long; perennial of short duration, scarcely indurated at base; local in Coachella Valley 289zd. var. *coachellae* (p. 951)
 31. Longest hairs up to 1.1–2 mm. long; stout perennial with woody base; local in Eureka Valley, Inyo County

- 289ze. var. *micans* (p. 952)
30. Calyx-teeth less than 1.4 mm. long; Mohave Desert; cf. zb. var. *variabilis*.
29. Herbage green or cinereous, but neither silvery nor satiny; wide-spread over the w. and centr. Mohave Desert 289zb. var. *variabilis* (p. 948)
28. Plants of the interior states, Nevada, Utah, Arizona, and extreme n. Mexico (32)
32. Distribution s. of the Mogollon mountain system, s. Arizona and New Mexico to adjoining Mexico 289u. var. *australis* (p. 941)
32. Distribution n. of the Colorado River in Arizona, to Utah and Nevada (33)
33. Pod glabrous, but the herbage and stem villosulous; w.-centr. Nevada 289za. var. *Kennedyi* (p. 947)
33. Pod either glabrous or pubescent, but if glabrous the stems and herbage glabrescent or thinly strigulose, and if the stem or herbage villosulous the pod pubescent (34)
34. Herbage green, the stems glabrous or nearly so; *pod* glabrous 289x. var. *vitreus* (p. 944)
34. Herbage cinereous, the stems canescent; *pod* pubescent 289w. var. *stramineus* (p. 943)
1. Pod scarcely or not inflated, the body slenderly ellipsoid or linear-ellipsoid, not over 7 mm. in diameter, mostly not over 5 mm. in diameter, several times longer than wide (35)
35. Flowers small (whitish) the keel less than 8.5 mm. long; cf. forms of a. var. *lentiginosus* with uninflated pod from interior Oregon and s. Idaho.
35. Flowers larger, commonly purple or purplish; dispersal southern (36)
36. Herbage silvery- or satiny-pubescent; *pod* silvery-canescant; deserts of s.-e. California, adjoining Arizona (Yuma Desert) and Mexico 289zf. var. *borreganus* (p. 953)
36. Herbage green or cinereous; *pod* glabrous or thinly pubescent, never canescent; distribution otherwise (37)
37. Raceme-axis elongating, over 4 cm. and up to 20 cm. long in fruit (38)
38. Petals ochroleucous; local in Maricopa County, Arizona 289zg. var. *maricopae* (p. 954)
38. Petals purple (39)
39. Pod papery-membranous, the valves transparent; cf. uninflated forms of x. var. *vitreus* (s.-w. Utah and adjoining Arizona) and u. var. *australis* (s.-e. Arizona)
39. Pod leathery or stiffly papery, not transparent (40)
40. Flower relatively large, the keel 10–15 mm., the calyx 6.3–9.5 mm. long; Arizona along and n. of the Colorado River to s. Utah and s.-w. Colorado 289zh. var. *palans* (p. 955)
40. Flower small, the keel $\pm$ 8.5 mm., the calyx $\pm$ 5 mm. long; local in s.-w. Utah 289zi. var. *ursinus* (p. 956)
37. Raceme-axis not elongating, 1–4 cm. long in fruit (41)
41. Petals lively pink-purple; Mohave, Coconino, and Navajo Counties, Arizona, to Utah and s.-w. Colorado 289zh. var. *palans* (p. 955)
41. Petals whitish or faintly pink-tinged; upper Verde Valley and Flagstaff Plateau, Yavapai and adjoining Coconino and Gila Counties, Arizona 289zj. var. *Wilsonii* (p. 957)

289a. ASTRAGALUS LENTIGINOSUS var. LENTIGINOSUS

Perennial, slender, thinly strigulose with subappressed, straight hairs up to 0.35–0.55 mm. long, the herbage green, the leaflets nearly glabrous on both sides and ciliate, sometimes thinly pubescent, especially toward the midrib, beneath; *stems* decumbent or prostrate, 1–3 (5.5) dm. long, commonly simple and floriferous upward from near the middle, sometimes branched at 1–6 nodes preceding the first peduncle; *stipules* submembranous, (1.5) 2–6 mm. long, glabrous or nearly so dorsally; *leaves* 3–10 cm. long, with (5) 9–17 (19) broadly obovate, obovate-cuneate, or oblong-elliptic, sometimes partly suborbicular or oblanceolate, mostly retuse or obtuse, sometimes truncate and apiculate, flat leaflets (3) 5–15

(18) mm. long; *peduncles* 1–3.5 cm. long, incurved-ascending at anthesis, reclinate in fruit; *racemes* 8–18 (22)-flowered, the axis 0.5–3 (3.5) cm. long in fruit; *bracts* 1–2.5 mm. long; *pedicels* at anthesis 1–1.7 mm., in fruit 1.4–2.5 mm. long; *calyx* 4.1–6.4 mm. long, thinly strigulose with black, white, or mixed hairs, the subsymmetric disc 0.5–0.9 (1) mm. deep, the campanulate tube 2.8–4.2 mm. long, 1.7–2.5 mm. in diameter, the subulate teeth 1–2.2 mm. long; *petals* whitish or yellowish, the keel-tip and sometimes the base of wings and banner faintly lilac-tinged; *banner* rhombic-oblongate or elliptic, 7.4–11 mm. long, 4.5–6.2 mm. wide; *wings* 7.1–9.4 mm. long, the claws 2.5–3.9 mm., the blades 4.7–6.5 mm. long, 1.1–2 mm. wide; *keel* (mostly 0.6–1.9 mm. shorter, rarely up to 0.6 mm. longer than the wings) 6.3–8.4 mm. long, the claws 2.7–4 mm., the blades 3.4–5.6 mm. long, 1.7–2.4 mm. wide; *anthers* 0.35–0.55 mm. long; *pod* humistrate, variable in size, outline, and curvature, obliquely ovate- to lance-acuminate in profile, strongly to scarcely inflated, 1–2.3 cm. long, (3) 4.5–10 mm. in diameter, lunately to hamately incurved, rounded (rarely broadly cuneate) at base, tapering or abruptly contracted distally into an unilocular beak 4–9 mm. long, the body a little obcompressed, when inflated sulcate along both sutures, when tumescent sulcate only ventrally or only dorsally, the stiffly papery or subcoriaceous, pale green but often purple-speckled or -mottled, thinly strigulose (exceptionally glabrous) valves becoming stramineous or brownish, cross-reticulate, not diaphanous, the septum complete or nearly so, (1.8) 2–5 (6.5) mm. wide, the funicular flange 0.4–1 mm. wide; *ovules* (15) 16–21.—Collections: 73 (iii); representative: *J. W. Thompson* 9100 (NY, POM, WTU), 11,440 (CAS, GH, NY, WTU); *Piper* 2674 (GH, NY, WTU); *Ripley & Barneby* 10,909 (CAS, RSA, WTU); *Macbride* 896 (GH, NY, POM, SMU, UC, WTU); *Heller* 8062 (GH, NY, UC, WIS); *Austin & Bruce* 2210 (NY, UC); *J. T. Howell* 12,437 (CAS, POM).

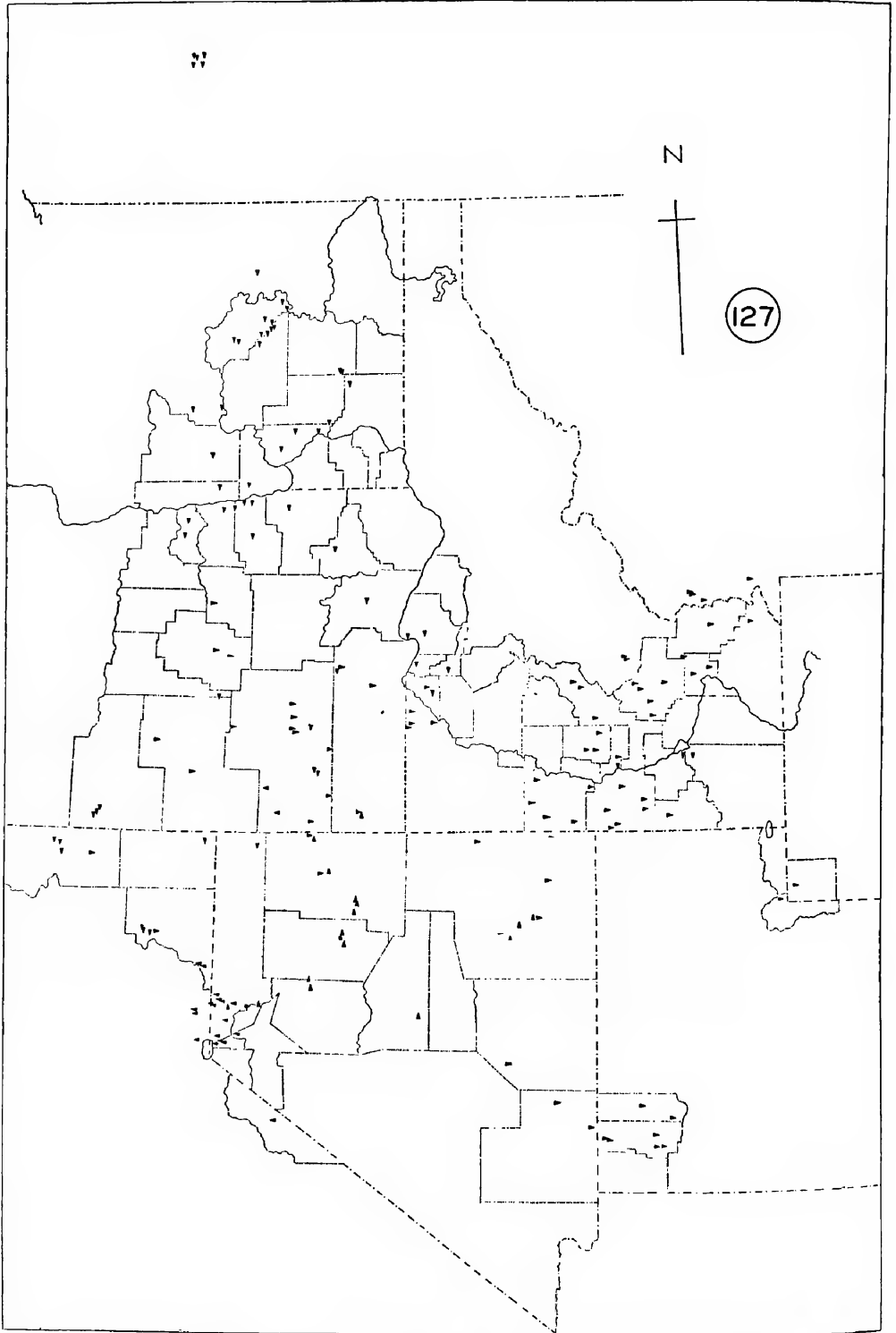
Dry plains and hillsides, in volcanic soils, commonly on basalt, among sagebrush or sometimes in open yellow pine forest, 750–4750 feet, widespread and locally plentiful in the Columbia Basin from Fort Okanogan south through transmontane Washington and Oregon to the Klamath Basin and Lassen County in northeastern California and to extreme northwestern Nevada; southeast in scattered stations up the Snake River to Pocatello, Idaho; apparently somewhat isolated on the Fraser River (Kamloops and vicinity) in southern British Columbia.—Map No. 127.—May to early July.

ASTRAGALUS LENTIGINOSUS (freckled or spotted, of the pod) Dougl. ex Hook., Fl. Bor.-Amer. 1: 151. 1831.—“Subalpine ranges of the Blue Mountains of North-West America. Douglas.”—Holotypus, from “near the sources of the Wallahwallah and Utala rivers,” K! isotypi, BM, GH (a single pod), OXF!—*Tragacantha lentiginosa* (Dougl.) O. Kze., Rev. Gen. 946. 1891. *Phaca lentiginosa* (Dougl.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 368. 1906. *A. lentiginosus* var. *typicus* Barneby in Leaf. West. Bot. 4: 81. 1945.

Astragalus lentiginosus var. *carinatus* (keeled, of the exerted keel-petals) Jones, Rev. Astrag. 125, Pl. 24. 1923.—“Baker City, Oregon, on flats, June 11, 1902 . . .”—Holotypus, collected by M. E. Jones, POM!

The typical variety of the freckled milk-vetch is the prototype of a series of forms which have in common prostrate or diffuse stems and compact, shortly pedunculate racemes of small, whitish flowers. It is the only *astragalus* of its sort in Washington and British Columbia, but southward it is sympatric with var. *salinus* and var. *platyphyllidius*, both of which are or may be at times closely similar in habit and vesture. The former is distinguished ideally by its thinly papery, translucent pod, but south of the Blue Mountains ambiguous populations are quite frequent. The flower of var. *platyphyllidius*, which has normally a larger pod of stiffer texture than that of var. *lentiginosus*, is commonly much larger, the banner nearly always over 14 mm., not 7.5–11 mm. long.

The pod of var. *lentiginosus* varies considerably in the degree of inflation; forms with strongly incurved and little-swollen pods are rather common toward the southeast and south limits of the variety's range in Idaho and California. An extreme example from Idaho (*Mrs.*



Map No. 127. Transmontane Oregon and Washington, Idaho, Nevada, and parts of adjoining states. Range (in part) of *A. lentiginosus*:  *var. lentiginosus*;  *var. salinus*;  *var. macrolobus*; and  *var. floribundus*.

Soth 399) has been illustrated (Barneby, 1945, Pl. 1, fig. 3). I no longer feel justified in maintaining Jones's var. *carinatus* (= var. *cuspidocarpus* sensu Jeps., 1936, p. 356) which I formerly (l.c.) distinguished by its "regularly falcate legume devoid of ventral sulcus." The degree to which the pod is grooved, whether dorsally or ventrally, is a function of the inflation modified by the curvature, and is too variable to serve as a differential character. The plants of northeastern California and the lake country of nearby Oregon have a certain individual facies but apparently no unique attribute. The typus of var. *carinatus* was a peculiar plant from the Blue Mountains with petals irregularly graduated, the keel being enlarged and shortly exerted from between the wings. A similar form has been collected in Modoc County, California, and represents no more than a rare and casual aberration, known to occur also in var. *platyphylidius*.

289b. *ASTRAGALUS LENTIGINOSUS* var. *SCORPIONIS*

Closely resembling var. *lentiginosus*, the decumbent or prostrate stems slender, 0.5–3 dm. long; *leaflets* 13–19, oval, elliptic-oblongate, or obovate, subacute, truncate and mucronulate, or retuse, thin-textured, 5–15 mm. long; *peduncles* usually very slender, 1.5–6 (8) cm. long; *racemes* 10–18-flowered, the axis 1.5–4 (5) cm. long in fruit; *calyx* 4.2–7 (8.4) mm., the tube 2.7–4.2 (5.3) mm., the teeth 1.5–3.2 mm. long; *petals* whitish or obscurely lavender-tinged; *banner* 8.5–12.2 (13.5) mm. long; *wings* 7.4–9.5 (11.5) mm., the blades 4.8–6.2 mm. long; *keel* 6.3–8.2 (11) mm., the blades (3.2) 3.5–5 (5.5) mm. long; *pod* narrowly to broadly ovoid-acuminate, usually much inflated, 8–20 (25) mm. long, 4.5–12 (15) mm. in diameter, the incurved, triangular-acuminate, unilocular beak 3–10 mm. long, the papery, usually but not always mottled, lustrous valves glabrous; *ovules* (7) 16–25.—Collections: 11 (i); representative: *Heller 9250* (NY); *Holmgren 1815* (NY); *Raven 11,490* (NY); *Maguire & Holmgren 21,875* (NY, UTC, WTU); *Ripley & Barneby 9315* (CAS, RSA).

Open rocky crests, mountain meadows, brushy hillsides, mostly on limestone or on limey clay soils, ascending from the upper edge of the sagebrush zone to near timber line, 7000–11,000 feet, locally plentiful in scattered stations in the Ruby, White Pine, and Grant Ranges in Elko, White Pine, and northeastern Nye Counties, south to Morey Peak in Lincoln County, Nevada, and in the Deep Creek Range, western Juab County, Utah.—Map No. 130.—June to August.

ASTRAGALUS LENTIGINOSUS var. *SCORPIONIS* (of the scorpion, the pod likened to the talon-shaped, terminal segment of the tail) Jones, Rev. Astrag. 124, Pl. 24. 1923.—"Morey Peak Nevada No. 6365 Purpus . . ."—Holotypus, POM!—The paratype mentioned by Jones = var. *lentiginosus*.—*Cystium scorpionis* (Jones) Rydb. in N. Amer. Fl. 24: 411. 1911.

Astragalus lentiginosus var. *tremuletorum* (of aspen groves) Barneby in Leaflet West. Bot. 4: 85, Pl. 1, figs. 13–17. 1945.—"Meadow, 8500 ft., upper Lamoille Canyon, Elko Co., Nevada, P. A. Munz No. 16324."—Holotypus, collected August 1, 1940, POM!

The var. *scorpionis* is very closely related to var. *lentiginosus*, from which it differs chiefly in the glabrous fruit. The var. *lentiginosus* is a lowland plant confined to basalt bedrock; the present variety is montane and calciphile. At the time that var. *tremuletorum* was described, very little material of *A. lentiginosus* from the mountains of Nevada was available for comparison; consequently I made several blunders in interpreting the superficially similar phases of var. *scorpionis* and var. *toyabensis*. The collection from the Toiyabe Mountains originally referred to var. *tremuletorum* is in reality var. *toyabensis*, as would be expected from the locality. The two varieties native to the mountains of Nevada vary equally in stature according to site and elevation, and both present phases of the pod which are little inflated and of the "scorpionis" type, shaped, that is, like the stinging segment of a scorpion's tail. The calcifuge var. *toyabensis* differs from var. *scorpionis* chiefly in its larger, more richly colored flowers.

289c. *ASTRAGALUS LENTIGINOSUS* var. *SALINUS*

Perennial but usually of short duration, strigulose with all or largely appressed (rarely some narrowly ascending, but never curly) hairs up to 0.35–0.6 mm. long, the herbage dark green, subglaucous, or subcinereous, the leaflets glabrous on both sides and thinly ciliate, glabrous above, wholly glabrous, or equally pube-

scent above and beneath; *stems* several, diffuse and ascending in low clumps, (0.6) 1–3 dm. long, simple, forked at base, or branched at 1–2 nodes preceding the first peduncle, floriferous upward from near or below the middle; *leaves* 4–10 cm. long, with (9) 11–19 broadly obovate, obovate-cuneate, obcordate, or sometimes broadly oblong or oblanceolate, mostly retuse or emarginate, sometimes obtuse and apiculate, rarely subacute, nearly always flat leaflets 5–20 mm. long; *peduncles* 2–4.5 (5) cm. long; *racemes* 10–25-flowered, loose or early becoming so, the axis little elongating, 1.5–4 (6, exceptionally up to 9) cm. long; *calyx* 5–6.4 mm., the tube 3.6–4.2 (4.6) mm. long, 1.9–2.5 (2.8) mm. in diameter, the teeth 1.2–2.2 (2.4) mm. long; *petals* whitish, immaculate, or the keel, and sometimes the wings also, tipped with pinkish-lilac; *banner* 9.5–11.5 (13.3) mm. long, 5–6.8 mm. wide; *wings* (8) 8.5–10.6 (11.6) mm., the claws 3–4.3 (5.2) mm., the blades 5.7–7 mm. long, 1.1–2 mm. wide; *keel* (6) 7–8 (9.6) mm. long, the claws (3.2) 3.6–4.2 (5.4) mm., the blades (3.2) 3.6–4.6 mm. long, 2–2.4 mm. wide; *pod* obliquely ovoid or subglobose, 1.4–2.6 (3) cm. long, (6) 7.5–14 mm. in diameter, nearly always greatly inflated, contracted distally into an erect or incurved, triangular or lanceolate, unilocular beak 3–9 mm. long, the thin, green or faintly (rarely brightly) mottled, glabrous or rarely puberulent valves becoming papery-membranous or thinly papery, stramineous, lustrous, the complete septum up to 5.5 mm., the funicular flange up to 1.2 mm. wide; *ovules* (16) 18–26.—Collections: 80 (x); representative: *J. W. Thompson* 12,167 (GH, NY, WTU); *M. & G. Ownbey* 2784 (RSA, WS); *Cronquist* 7272 (ID, NY, RSA); *Nelson & Macbride* 1281 (F, GH, ID, NY, POM, SMU, UC), 1575 (F, GH, NY, POM, SMU, UC), 2199 (GH, ID, NY); *Ripley & Barneby* 4969 (RSA); *Jones* 1813 (GH, NY, POM).

Dry hillsides among sagebrush, alkaline flats, and on playas or about depressions on sagebrush plains, 2300–6250 (8400) feet, widespread and sometimes forming extensive colonies, transmontane Oregon, mostly south of the Blue Mountains but extending to the John Day Valley in Wheeler County and the head of Deschutes River in Crook and Deschutes Counties, east up the Snake River Plains and the delimiting foothills to Fremont, Jefferson, and Oneida Counties, Idaho, Red Rock Creek in Beaverhead County, Montana, and the Bear River in extreme southwestern Wyoming and immediately adjacent Utah, southwest, becoming rare and passing into var. *floribundus*, to Siskiyou and Lassen Counties, northeastern California, and, passing into var. *macrolobus*, into the northern tier of counties in Nevada, south in scattered stations in eastern Nevada to the head of the Muddy River in Lincoln County, and thence east, locally abundant, over the Escalante Desert in Iron and Beaver Counties, Utah.—Map No. 127.—April to June.

ASTRAGALUS LENTIGINOSUS var. *SALINUS* (Howell) Barneby in Leaf. West. Bot. 4: 86. 1945, based on *A. salinus* (of saline soil) Howell in Erythea 1: 111. 1893.—“Saline soils of southeastern Oregon.”—Holotypus, *Howell* 799, collected in Harney Valley, Harney County, Oregon, June 10, 1885, ORE! isotypi, F, G, ND, UC, WTU!—*Cystium salinum* (Howell) Rydb., Fl. Rocky Mts. 1063. 1906.

Cystium heliophilum (sun-loving) Rydb., Fl. Rocky Mts. 491, 1063. 1906.—“Type: Lima, Mont., July 1, 1895, *C. L. Shear* 3430 . . .”—Holotypus, NY!—*Astragalus heliophilus* (Rydb.) Tidest. in Contrib. U. S. Nat. Herb. 25 (Fl. Nev. Utah): 325. 1925.

The var. *salinus* is so circumscribed as to include all forms of the freckled milk-vetch in which small, whitish flowers, giving rise to pods of thinly papery or papery-membranous texture, are arranged in short, comparatively loose racemes (not in heads or spikes as in var. *floribundus*) and are combined with broad, flat leaflets loosely spaced along the rachis. The nomenclaturally typical form of this variety, especially common in southeastern Oregon but extending into southern Idaho, is nearly glabrous, with dark green leaflets of rather thick texture and consistently glabrous pod; the material from northeastern California is largely of the same sort. The var. *salinus* is very close to var. *floribundus*, into which it passes in Washoe

County, Nevada. Eastward from the Humboldt-Snake water parting in southeastern Oregon one encounters with increasing frequency plants pubescent to varying degree with appressed hairs, the leaflets now thinly hairy only on the lower surface, now quite densely so on both sides. Occasionally in plants of this type the pod also becomes strigulose (e.g., *Christ & Christ 18,317*, *Ripley & Barneby 9359*, both RSA). A series of variants illustrating transition from green to cinereous herbage can be selected out of any considerable collection; and even though there is a certain geographic correlation with type and amount of pubescence, the more hairy eastern phase (= *Cystium heliophilum*) is reasonably disposed of as a minor variant. The occasional forms with puberulent pods are uncomfortably close to var. *lentiginosus* which is, however, ideally and usually distinguished by its fruits of thicker texture. In some of the more densely hairy populations I also find a tendency toward a loosening of the hairs; when this occurs with comparatively long calyx-teeth and pubescent pod, it is the expected intergrade between var. *salinus* and the largely Nevadan var. *macrolobus*. The var. *salinus* is very common in southern Idaho and the Great Basin drainage in Oregon, but in its southward extension through eastern Nevada to southwestern Utah it is known only from scattered stations. At its south limit in and around Esclante Desert, it is represented by a subglabrous phase, the flowers of which are slightly above average size and the petals all, or at least the wings and keel, tipped with pinkish-lilac. This last suggests passage into var. *Fremontii*, but I have no evidence of truly intermediate forms in this region. In exceptional individuals, sometimes in whole populations, the raceme-axis elongates considerably after or during late anthesis (e.g., *Christ 14,491*, NY, RSA, in part). Although there is no doubt as to their identity, such plants cannot be distinguished technically from albino forms of var. *Fremontii*.

Speaking of var. *salinus* (1945, l.c.) I have ventured the opinion that because of its morphologically central position it might be primitive in relation to its group of forms or even to the whole species-complex of *A. lentiginosus*. After reflection I must retract the corollary, which now seems to have neither logic nor likelihood to recommend it, but there can be no harm in placing new emphasis on the web of relationships of which so many strands meet in var. *salinus*. Starting from this point, it is possible to trace an almost uninterrupted sequence of variations passing through var. *floribundus* to var. *ineptus*, and thence to var. *antonius*, var. *sierrae*, and var. *idriensis*, the last with large, purple flowers. Another strand leads through var. *lentiginosus* and the large, but still white-flowered var. *platyphyllidius* to var. *araneosus*, var. *diphysus*, and finally var. *australis*, the last with large, loosely racemose, purple flowers. And by way of var. *macrolobus*, var. *Fremontii*, and var. *stramineus*, one arrives by another route among the loosely racemose southern varieties of which var. *yuccanus* and var. *australis* are characteristic examples. Truly var. *salinus* occupies a crucial position in *A. lentiginosus*, serving, as it does, to link together so many superficially disparate lines of differentiation in the complex.

289d. ASTRAGALUS LENTIGINOSUS var. FLORIBUNDUS

Similar to var. *salinus* but often more robust, the glabrous or thinly strigulose stems prostrate or weakly ascending, (2) 2.5–5 dm. long, nearly always branched or spurred in the lower half, the herbage green, the leaflets usually glabrous on both sides but ciliate, sometimes thinly strigulose beneath, rarely so above; *leaves* 3–8 (11) cm. long, with 11–15 (19) obovate, obovate-cuneate, oblong-obovate, or oblanceolate, mostly retuse, rarely subacute, flat or (in some upper leaves) folded leaflets 5–15 mm. long; *peduncles* 1–4 (7) cm. long; *racemes* at first dense, (11) 15–30 (37)-flowered, the axis more or less elongating, 1–4 (10) cm. long in fruit, the pods crowded into dense, subglobose or cylindric heads; *calyx* 4–5.6 (6) mm. long, the tube 3–4 mm. long, 1.9–2.5 mm. in diameter, the teeth 0.6–1.4 (2) mm. long; *petals* whitish, the keel- and sometimes the wing-tips faintly lilac-tinged; *banner* broadly to narrowly rhombic-obovate, 8.8–11 (11.6) mm. long, 4–5.6 (6.2) mm. wide; *wings* 8.2–10.2 mm., the blades 5–6.7 mm. long; *keel* 6.6–8 mm., the blades 3.5–4.5 mm. long; *pod* obliquely ovoid-acuminate or subglobose, greatly inflated, (0.8) 1.2–2.1 cm. long, (6) 7–12 mm. in diameter, the strongly incurved or suberect, triangular-acuminate beak 3–7 mm. long, the papery, often faintly mottled, at length stramineous valves glabrous or thinly strigulose; *ovules* 15–21 (25)—Collections: 26 (ii); representative: *Jones 2990* (GH, NY, POM, UC); *Kennedy 2072* (GH, NA, POM, UC); *Ripley & Barneby 5878* (CAS, NY, RSA); *Watson 238* (GH, p.p.).

Sagebrush valleys and brushy hillsides, in dry, commonly sandy, granitic or basaltic soils, 3800–5200 feet, locally plentiful and rather common along the east base of the Sierra Nevada from near Lake Tahoe north to Sierra Valley, in southern Washoe, Ormsby, and Lyon Counties, Nevada, and adjoining Sierra and Placer Counties, California, north in scattered stations to extreme southern Oregon, there passing into var. *salinus*; in Mono County passing south into var. *ineptus*.—Map No. 127.—May to July.

ASTRAGALUS LENTIGINOSUS var. *FLORIBUNDUS* (abounding in flowers) Gray in Proc. Amer. Acad. 6: 524. 1865.—“Nevada, near Carson City, Dr. C. L. Anderson.”—Holotypus, *Anderson 157*, collected in 1864, GH! isotypi, NY, US!—*Cystium floribundum* (Gray) Rydb. in N. Amer. Fl. 24: 411. 1929.

Cystium ormsbyense (of Ormsby County, Nevada) Rydb. in N. Amer. Fl. 24: 412. 1929.—“Type collected in Eagle Valley, Ormsby County, Nevada, 1902, *Baker 1275* . . .”—Holotypus (*C. F. Baker*), NY! isotypi F, ND, POM, UC!

The var. *floribundus* reaches its characteristic development in the Sierra foothills and piedmont valleys between Sierra Valley and Lake Tahoe, where it is the only known representative of the freckled milk-vetch and easily recognized by its branching stems, by the length of the internodes relative to the short, often subsessile leaves, and by the racemes of relatively numerous flowers which give rise to compact globose or cylindric heads of bladderly fruits. Even in this small area, however, several minor variants occur, forms almost glabrous and others thinly pubescent throughout, forms with glabrous and others with strigulose pods (the differential feature of *C. ormsbyense*), and forms characterized by broad and flat or alternatively with narrow and folded leaflets. Northward the variety passes insensibly into var. *salinus* and southward (cf. *Rose 50,159*, CAS, NY, RSA, from Bridgeport, Mono County) into the montane var. *ineptus*, which differs ideally (and in the Sierra Nevada proper almost consistently) in its more loosely strigulose or villosulous vesture.

In southeastern Harney County the late Prof. Peck collected in moist ground near Whitehorse Ranch a set of remarkable variants which deserve further study. One of these plants (*Peck 27,277*) is fairly typical var. *salinus*. Another (*Peck 27,316*) has rather firmer, ellipsoid pods and a raceme-axis reaching 6–11 cm. in length, and might be referred to var. *floribundus* although it is far from characteristic. A third (*No. 27,321*) has loosely racemose fruits of the var. *salinus* type and is somewhat intermediate between the other two except that the pod's valves are strigulose. This puzzling group of plants (all at ORE) defies classification.

289e. *ASTRAGALUS LENTIGINOSUS* var. *MACROLOBUS*

Growth-habit and appearance of var. *salinus*, but villosulous with spreading and ascending, sinuous or curly, and sometimes some longer, straighter hairs up to 0.5–0.9 (1) mm. long, the herbage cinereous or greenish, the leaflets commonly pubescent on both sides or (transition to var. *salinus*) glabrate and ciliate; *leaves* 4–11 cm. long, with (9) 13–19 leaflets 4–20 mm. long; *peduncles* 2.5–7 cm. long; *racemes* (8) 12–30-flowered, loose or early becoming so, the axis (2) 3–7 (9) cm. long in fruit; *calyx* white- or partly black-villosulous, (4.5) 5–7.1 mm., the tube 3–3.8 mm. long, 2–2.6 mm. in diameter, the teeth (1.5) 2–3.3 mm. long, often spreading-recurved; *petals* whitish (exceptionally purple); *banner* 9.3–11.3 mm. long; *wings* 8.3–9.5 mm. long; *keel* 6.5–8 mm., the claws 3.7–4.5 mm., the blades 3.2–4.2 mm. long; *pod* as in var. *salinus*, 1.5–2.5 cm. long, (6) 8–14 mm. in diameter, pale green or sometimes faintly mottled, glabrous or strigulose; *ovules* 18–26.—Collections: 22 (ii); representative: *M. & G. Ownbey 2819* (CAS, NA, NY, RSA, WS); *Bunn 1534* (RSA); *Ripley & Barneby 4548, 5603* (CAS, RSA).

Sandy valleys, dunes, and sagebrush plains and hillsides, ± 3800–5600 feet, locally abundant in the lower Humboldt River and Quinn River Valleys in Humboldt, Pershing, Lander, and Churchill Counties, Nevada, passing north and east into var. *salinus* and west into var. *floribundus*.—Map No. 127.—April to July.

ASTRAGALUS LENTIGINOSUS var. *MACROLOBUS* (Rydb.) Barneby in Leaflet West. Bot. 4: 89, Pl. I, figs. 37–41. 1945, based on *Cystium macrolobum* (with long calyx-teeth) Rydb. in N.

Amer. Fl. 24: 408. 1929.—“Type collected at West Humboldt Mountains, Nevada, June, 1868, *Watson 254* in part (Torrey Herbarium).”—Holotypus, NY!

Cystium vulpinum (of foxes, the allusion not explained) Rydb. in N. Amer. Fl. 24: 409. 1929.—“Type collected in Grass Valley, Nevada, June, 1868, *Watson 254*, in part (Torrey Herbarium).”—Holotypus, NY!

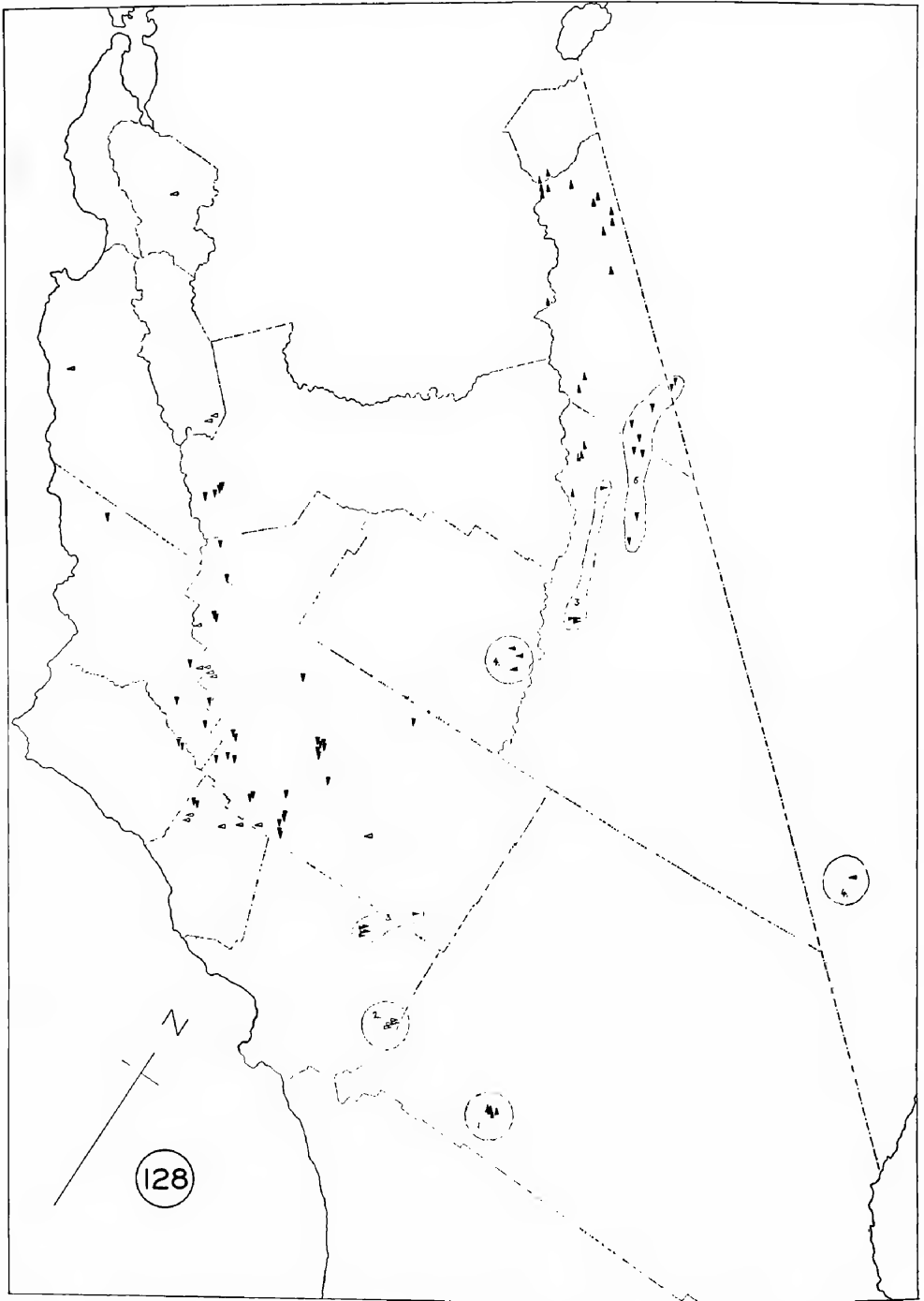
The var. *macrolobus* might possibly be passed over as a third pubescence-phase of var. *salinus*, coordinate with the nearly glabrous and cinereously strigulose ones already described, for it differs consistently in no other character. However the means of variation in length of fruiting raceme and calyx-teeth are substantially higher, and the variety, as defined primarily by its villosulous vesture, occupies an extensive area to the exclusion of its close relative. In my revision (1945, p. 89) I included in the description and exsiccata a number of specimens from Elko and Washoe Counties which differ from var. *macrolobus*, as redefined here, in their thinner or appressed pubescence or in the condensed raceme. I must now refer those that I have examined once again to var. *salinus* and var. *floribundus* respectively, although each is atypical in one or more characters. Intergradation with the ashen form of var. *salinus*, especially in southern Harney and Malheur Counties, and in southern Idaho eastward as far as Twin Falls County, has been mentioned under var. *salinus*. The pod of var. *macrolobus* may be either glabrous or pubescent (the latter is *Cystium vulpinum*), sometimes in a population of otherwise similar plants. On account of its loose raceme of small flowers and villosulous herbage, var. *macrolobus* closely mimics some forms of var. *Fremontii*, the range of which lies, however, much farther southward. A rare form of var. *macrolobus* with purple flowers is technically indistinguishable from var. *Fremontii*. It has been collected twice, by Jones at Rose Creek in Humboldt County, and by Mrs. Van Dyke somewhere along the Victory Highway between Elko and Winnemucca. Jones's collection is partly purple- and partly white-flowered.

289f. ASTRAGALUS LENTIGINOSUS var. INEPTUS

Diffuse or decumbent, the slender stems radiating from the root-crown or caudex at or (especially in loose scree above timber line) just below soil-level, (1) 3–25 (30) cm. long, the herbage greenish-cinereous, loosely strigulose or villosulous with hairs up to 0.4–0.6 mm. long, the leaflets nearly always crowded, folded, glabrous or medially glabrescent above; *leaves* 1.5–5.5 cm. long, with (9) 15–21 obovate or oblanceolate, obtuse or retuse leaflets (1) 2–10 mm. long; *peduncles* 0.5–2 cm. long, much shorter than the leaf; *racemes* shortly but loosely (4) 10–21-flowered, the axis (0.3) 1–2.5 cm. long in fruit; *calyx* (4.8) 5.4–7.3 mm., the tube (3.6) 3.9–4.9 mm. long, 1.9–2.7 mm. in diameter, the teeth (1) 1.2–2.4 mm. long; *petals* whitish or cream-colored, the banner, wing- or keel-tips sometimes pink-suffused; *banner* (8.8) 9.8–12.2 mm. long; *wings* (8) 8.5–11.2 mm., the blades (4.8) 5.5–6.9 mm. long; *keel* 7.2–9.3 mm. long, the blades 3.6–5 mm. long; *pod* plumply ovoid- or ellipsoid-acuminate, 1–1.8 cm. long, the bladdery-inflated body (5) 6–12 mm. in diameter, tapering or abruptly contracted distally into the erect or incurved, triangular, unilocular beak, the thinly papery, usually faintly mottled valves becoming stramineous, somewhat lustrous, strigulose or exceptionally glabrous; *ovules* (12) 14–19.—Collections: 23 (ii); representative: *Wiggins 9312* (POM, UC), *11,184* (NY, WS); *Peirson 10,743* (RSA, UC), *10,758* (RSA); *Alexander & Kellogg 4036* (NY, WS); *Ripley & Barneby 4077* (CAS, RSA); *J. T. Howell 23,829, 24,009* (RSA).

Open gravelly slopes, crests, and talus, in coarse granite-sand or volcanic tuff, (6600) 7000–11,400 (12,000) feet, frequent and locally plentiful along the east face of the Sierra Nevada from Alpine County to the Inconsolable Range in Inyo County; Sweetwater Mountains, Mono County; extending just west of the Sierra crest to Bonita Meadow in Tulare County.—Map No. 128.—June to August.

ASTRAGALUS LENTIGINOSUS var. INEPTUS (Gray) Jones, Rev. Astrag. 124. 1923, based on *A. ineptus* (awkward, the species described as “homely”) Gray in Proc. Amer. Acad. 6: 525. 1864.—“Dry, rocky mountain near Sonora Pass, 9000 ft.”—Holotypus, collected in 1863 by Brewer, GH! isotypi, P, UC, US!—*Phaca inepta* (Gray) Rydb. in Mem. N. Y. Bot. Gard. 1: 246. 1900 (quoad nom.). *Cystium ineptum* (Gray) Rydb. in Bull. Torr. Club 32: 659. 1905, & in op. cit. 40: 51. 1913.



Map No. 128. Parts of central and southern California and adjoining Nevada. Range (in part) of *A. lentiginosus*: ▲ var. *ineptus*; ▲ (circled, No. 1) var. *sierrae*; ◊ (circled, No. 2) var. *antonius*; ◊ (circled, No. 3, bicentric) var. *albifolius*; ◊ (circled, No. 4, bicentric) var. *kernensis*; ▼ (circled, No. 5) var. *semotus*; ◊ var. *idriensis*; and ▼ var. *nigricalycis*.

The var. *ineptus* is characteristically developed at elevations above 8000 feet along the dry eastern face of the Sierra escarpment, where it extends upward through the belt of *Pinus aristata* into the treeless zone of alpine fell-fields. In this region it is common and with the exception of a rare, high-ranging form of the ordinarily lowland var. *Fremontii*, which differs in its loosely racemose, purple flowers, it is the only form of *A. lentiginosus* to be expected. The typical and prevalent phase of var. *ineptus* is a slender plant, with short leaves, small and crowded, usually folded leaflets and very shortly pedunculate racemes of creamy-white flowers often tinged with dull lilac. In Mono County it descends to sandy banks and pumice fields about the head of the Owens and Walker Rivers, and there passes by imperceptibly gradual steps into the coarser, mostly more northern and lowland var. *floribundus*. Occasional specimens from the Sweetwater Mountains (e.g., *Munz 21,234*, NY) suggest passage into the closely related var. *semotus*, of which the ideal differential characters are mentioned below. Care is necessary in distinguishing from var. *ineptus* the very local Sierran endemic *A. Ravenii* which differs in its smaller flowers, shallowly campanulate calyx-tube, and subunilocular pod with only a quite narrow and incomplete septum. In the Sweetwater Mountains var. *ineptus* may be found growing with *A. platytropis*, the pod of which is inflated and bilocular, and which differs in its subcaulescent growth-habit and smaller, differently proportioned flowers with all petals of nearly equal length.

289g. ASTRAGALUS LENTIGINOSUS var. SEMOTUS

Loosely tufted, the slender, closely leafy stems commonly all short, up to 1 dm. (or in transition to var. *ineptus* up to 2 dm.) long, the internodes only 3–12 (30) mm. long, the herbage greenish-cinereous, strigulose with subappressed hairs up to 0.35–0.5 mm. long, the leaflets thinly pubescent or glabrous above; *leaves* 4–9 cm. long, with (13) 17–27 rather distant, oblanceolate, oblong-oval, or -elliptic, obtuse or emarginate, nearly always folded leaflets 2–9 mm. long; *peduncles* very slender, 0.6–1.5 cm. long, the fruiting racemes often appearing subradical; *racemes* about 6–10-flowered, the fruiting axis 1–3 cm. long; *calyx* 5.2–7.3 mm., the tube 3.6–5 mm. long, the subulate teeth 1.5–2.6 mm. long; *petals* whitish; *banner* 10.4–12 mm. long; *wings* 9.4–10.5 mm., the blades $\pm$ 6.5 mm. long; *keel* 7.7–8.5 mm., the blades 4.1–4.5 mm. long; *pod* ovoid-acuminate, bladderly-inflated, 1.1–2 (2.3) cm. long, 6–12 mm. in diameter, the incurved, unilocular beak 4–7 mm. long, the papery, mottled valves sparsely strigulose; *ovules* 13–15.—Collections: 14 (o); representative: *Munz 21,047* (RSA), 26,037 (NY, RSA, WS); *Maguire & Holmgren 26,126* (NY, RSA, WS); *Duran 2776* (GH, NY, OB, POM, UC, WIS); *J. & A. Roos 5965* (RSA).

Dry sandy or gravelly flats and hillsides, among sagebrush and with *Pinus aristata*, 7000–11,250 feet, locally frequent in the White and Inyo Mountains, Inyo and Mono Counties, California, and Esmeralda County, Nevada.—Map No. 128.—June to August.

ASTRAGALUS LENTIGINOSUS var. SEMOTUS (put asunder, of the distant leaflets) Jeps., Fl. Calif. 2: 357. 1936.—“White Mts., Inyo Co. . . Campito Mt., *Jepson 7280* . . .”—Holotypus, collected at 11,000 ft. on July 25, 1917, UC-JEPS!

The freckled milk-vetch of the White and Inyo Mountains, var. *semotus*, is very closely related to var. *ineptus*, which it replaces in the high desert ranges lying to the east of Owens Valley. The flowers and pods of the two forms are essentially identical; they differ principally in habit of growth, var. *semotus* having on the average shorter stems with leaves separated one from another by shorter internodes and composed of two or three more pairs of small leaflets which are disposed quite loosely along a much longer rachis. Typical var. *ineptus* has villosulous leaves, those of var. *semotus* are strigulose. Some specimens of var. *semotus* are, however, quite strongly caulescent (e.g., *Train 3940*, NA, NY, with stems up to 1 or even 2 dm. long) while a form of var. *ineptus* in the Rock Creek drainage in Inyo County (e.g., *Peirson 9155*, RSA) has relatively few but distant leaflets. The varieties are morphologically confluent.

289h. ASTRAGALUS LENTIGINOSUS var. SIERRAE

Strong perennial, diffuse or prostrate, the radiating stems 1–3.5 dm. long, forming loosely woven mats, the herbage green or greenish, thinly strigulose with

straight, subappressed hairs up to 0.3–0.5 mm. long, the leaflets glabrous on both sides and ciliate, or as often pubescent beneath; *leaves* 2–5 cm. long, with 15–21 usually crowded, sometimes imbricated, obovate or broadly oblanceolate, obtuse or emarginate, conduplicate and backwardly arched leaflets 3–8 mm. long; *peduncles* (0.7) 1–3 cm. long, much shorter than the leaf; *racemes* very shortly but loosely (5) 7–13 (15)-flowered, the axis (0.5) 1–3 cm. long in fruit; *calyx* 5–6 (6.6) mm. long, white-strigulose, the tube 4.3–4.8 (5.2) mm. long, 2.4–2.9 (3.3) mm. in diameter, the broadly subulate or deltoid teeth 0.5–1.2 (1.4) mm. long; *petals* whitish or faintly pink-tinged distally; *banner* 10.4–13 (14.5) mm. long, 5.1–7.5 (8) mm. wide; *wings* 9.4–11 (13.2) mm., the claws 4–4.7 (5.2) mm., the blades 6.2–7.2 (9) mm. long, 1.5–2.2 mm. wide; *keel* 8.1–9 (9.8) mm., the claws 4–4.6 (5.2) mm., the blades 4.5–5 mm. long, 2–2.5 mm. wide; *pod* plumply ovoid-acuminate or subglobose, 1.5–2.2 cm. long, (0.8) 1–1.5 cm. in diameter, the erect, triangular, unilocular beak 3–6 mm. long, the papery, mottled, strigulose valves becoming stramineous and sublustrous, the septum about 4–5 mm., the funicular flange about 1 mm. wide; *ovules* 17–24.—Collections: 18 (ii); representative: *Parry & Lemmon 91 in 1876* (GH, NY); *Parish 1867* (DS, F, ND, NY); *Jones* (from Bear Lake) *in 1926* (CAS, NY, POM); *Munz 10,468* (POM).

Stony meadows and open pinewoods, $\pm$ 6000–7000 feet, locally plentiful about the east end of the San Bernardino Mountains (Bear and Baldwin Lakes; Big Meadows), ascending south on Sugarloaf Mountain to 8500 feet, San Bernardino County, California.—Map No. 128.—May to July.

ASTRAGALUS LENTIGINOSUS var. *SIERRAE* (of the Sierra, a misleading epithet) Jones, Rev. Astrag. 124, Pl. 23. 1923.—“In gravelly soil Bear Valley California.”—Holotypus, collected by Jones in 1900, POM!—*Cystium sierrae* (Jones) Rydb. in N. Amer. Fl. 24: 412. 1929. *A. sierrae* (Jones) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937.

The var. *sierrae*, narrowly endemic to the lake basins at the east end of the San Bernardino Mountains and, contrary to expectations raised by the ill-chosen epithet, unknown from the Sierra Nevada, is in many respects intermediate between the Sierran var. *ineptus* and var. *idriensis* of the Coast Ranges. Closest to var. *ineptus*, the average plant having precisely the same growth-habit, small, pallid flowers, and papery pod, it may be recognized by its commonly thinner and more nearly appressed vesture and by the short, blunt calyx-teeth. The flowers of var. *idriensis* are ordinarily much larger and more brightly colored than those of var. *sierrae*, but some forms from the mountains around the head of San Joaquin Valley have flowers intermediate between the two in size and coloring, sometimes combined with the short calyx-teeth and crowded, conduplicate leaflets characteristic of var. *sierrae*. Such forms can be separated from var. *sierrae* by the pod of substantially thicker and stiffer texture.

289i. *ASTRAGALUS LENTIGINOSUS* var. *ANTONIUS*

Strongly perennial, with prostrate or diffuse stems (0.7) 1.5–3 dm. long, closely related to and resembling the last, but the stems and herbage densely strigulose with subappressed hairs up to 0.4–0.6 mm. long, cinereous or silvery-canescens, the leaflets pubescent on both sides, sometimes more densely so above than beneath; *leaves* 3–8 cm. long, with 11–19 (21) obovate or elliptic, obtuse or emarginate, flat or loosely folded leaflets (2.5) 4–11 mm. long; *peduncles* (1) 2–5.5 cm. long; *racemes* $\pm$ 10–15-flowered, the axis (0.5) 1–4 (5) cm. long in fruit; *calyx* 4.2–5.5 mm. long, white- or partly black-strigulose, the tube 3.2–4 mm. long, 1.8–2 mm. in diameter, the teeth 0.8–1.4 mm. long; *petals* purple, perhaps sometimes pale, the color fugacious; *banner* 9–10.5 mm. long; *wings* 7.9–10 mm., the blades 4.8–6.1 mm. long; *keel* 7.2–8.2 mm. long, the blades 3.7–4.3 mm. long; *pod* as in the preceding, 1.4–2.2 (3) cm. long, 1–1.6 (1.8) cm. in diameter; *ovules* 20–26.—Collections: 8 (o); representative: *Hall 1485*

(POM, UC); *Johnston 1655* (POM, UC); *J. T. Howell 23,406* (CAS, RSA); *Parish 1918* (ND, UC).

Dry slopes in open yellow pine forest, 5000–8500 feet, known only from the slopes of Mt. San Antonio (Old Baldy) and the Blue Ridge, east end of the San Gabriel Mountains, in eastern Los Angeles and adjoining San Bernardino Counties, California.—Map No. 128.—Late April to July.

ASTRAGALUS LENTIGINOSUS var. *ANTONIUS* (of Mt. San Antonio) Barneby in Leaflet. West. Bot. 4: 100, Pl. II, figs. 7–9. 1945.—“Type. Swartout Valley, San Bernardino Co., California, *J. B. Feudge* No. 990 . . .”—Holotypus, collected June 10, 1924, POM!

The var. *antonius* resembles the preceding at every point except for the gray or silvery vesture of the leaves, the usually flat rather than characteristically crowded and folded leaflets, and the slightly smaller flower which seems to be of a fairly lively shade of purple when fresh. The range of the two varieties *sierrae* and *antonius* collectively coincides almost exactly with that of *A. bicristatus* and (except for a southerly extension to the Santa Rosa Mountains) with that of *A. leucolobus*. This common pattern of dispersal must have been determined by one set of circumstances, but whereas the last two species have remained monomorphic in their bicentric ranges, the sensitively plastic freckled milk-vetches have differentiated out into perceptibly different forms.

289j. *ASTRAGALUS LENTIGINOSUS* var. *ALBIFOLIUS*

Perennial, slender but often vigorous, densely strigulose throughout or nearly so with appressed or subappressed hairs up to 0.35–0.65 mm. long, the herbage cinereous or silvery, the leaflets nearly always more densely pubescent above than beneath; stems prostrate or scrambling up through low shrubs, (1) 3–10 dm. long, simple or commonly divaricately branched at 1–6 nodes preceding the first peduncle, floriferous upward from up to 6–20 successive axils, flexuous or abruptly zigzag distally; leaves 2–9 cm. long, the upper ones subsessile and divaricate or recurved, the median ones often shorter than the internodes, with (9) 11–17 (21) oblanceolate, elliptic, or narrowly oblong, obtuse or subacute, mostly folded leaflets (3) 5–15 (18) mm. long; peduncles divaricate or ascending at a wide angle, (1) 1.5–6.5 cm. long; racemes (9) 12–35-flowered, at first dense, becoming a little looser in age, in fruit again dense, the pods crowded into subglobose or cylindric heads (0.5) 1–4 cm. long; calyx 5–7.3 mm., the tube 3.2–4.5 mm. long, 2.1–2.5 mm. in diameter, the subulate teeth 1.5–2.8 mm. long; petals whitish, or veined with purple on a whitish or yellowish ground, sometimes all but the pallid wing-tips reddish-purple; banner 8.2–11.5 mm. long; wings 7.7–10.6 mm., the blades 5.4–7.3 mm. long; keel 6–8.5 mm., the blades 3–4.4 mm. long; pod plumply ovoid-acuminate, bladdery-inflated, 0.9–1.7 cm. long, 8–14 mm. in diameter, broadly rounded or subumbilicate at base, the declined, triangular-acuminate beak 3–5 mm. long, the pale green but purple-mottled, strigulose valves becoming papery-membranous, subdiaphanous, stramineous and lustrous, the septum complete, 3–4.6 (5) mm. wide, the funicular flange 0.4–1.2 wide; ovules 10–15—Collections: 16 (iii); representative: *Elmer 3627* (CAS, NY, POM); *Ripley & Barneby 5853* (CAS, NY, RSA); *Purpus 5760* (POM, UC); *Alexander & Kellogg 3009* (NY, WS).

Alkaline, summer-dry flats on the desert floor and about seepage areas in the lower foothills, in stiff clay soils moist in spring, 2100–4700 feet, locally plentiful along the east base of the southern Sierra Nevada, California, but the known stations few and widely separated: Big Pine and Lone Pine, Inyo County; Muroc, Kern County; and extending over a rather extensive area around Lancaster, Los Angeles County.—Map No. 128.—April to July.

ASTRAGALUS LENTIGINOSUS var. *ALBIFOLIUS* (white-leaved) Jones, Rev. Astrag. 124, Pl. 23. 1923.—“Lone Pine Owen’s Valley California . . .”—Holotypus, collected May 14, 1897, by M.

E. Jones, POM! isotypi GH, NY!—*Cystium albifolium* (Jones) Rydb. in N. Amer. Fl. 24: 413. 1929. *A. albifolius* (Jones) Abrams, Ill. Fl. Pac. St. 2: 598, fig. 2874. 1944 (non Freyn & Sint., 1893).

The var. *albifolius* and the next in order, var. *sesquimetalis*, have become adapted to a specialized environment of alkaline flats and seepages, where the soil is waterlogged in spring and dries out slowly but never to any great depth during the heat of summer. The presence of water within permanent reach of the deeply penetrating taproot, even though this water may be almost saturated with mineral salts, enables the plants to maintain active growth for a month or more after the sympatric forms of *A. lentiginosus*, which are native to porous soils on the open desert floor, have perished or fallen into a dormant state; consequently the stems elongate almost indefinitely, sometimes becoming a yard in length. At first or permanently prostrate, trailing over the bare clay or through a thin carpet of saltgrass, the divaricately branching stems sometimes clamber up through low bushes of *Atriplex* or other suffrutescent halophytes and are difficult to extricate unbroken. The var. *albifolius*, which has essentially the flower of all nine varieties described up to this point, resembles some forms of var. *floribundus* in its short leaves, crowded leaflets, and densely many-flowered racemes, although these features are combined here with silvery (not green) herbage, the leaflets being ordinarily more densely pubescent above than beneath. The declined (that is forwardly and downwardly directed) beak of the pod is found in var. *albifolius* alone of all forms of the freckled milk-vetch and provides an easily observed differential character.

289k. ASTRAGALUS LENTIGINOSUS var. SESQUIMETRALIS

Prostrate perennial, resembling var. *albifolius* in habit, strigulose with subappressed hairs up to 0.35–0.5 mm. long, the stems stramineous, the herbage greenish, the leaflets glabrous or thinly strigulose above; *stems* up to "2½ ft" (7–8 dm.) long, apparently branching below the middle, simple distally; *leaves* 2–5 dm. long, mostly shorter than the internodes, subsessile, with 9–15 (17) oblanceolate, flat or loosely folded leaflets 6–18 mm. long, the terminal one the longest; *peduncles* 1.5–4 cm. long; *racemes* shortly but loosely 6–12-flowered, the axis $\pm$ 1–2 cm. long in fruit; *calyx* 7–8 mm. long, white-silky, the tube 4.8–5.5 mm. long, 2.5–2.7 mm. in diameter, the teeth 2.2–2.5 mm. long; *petals* purple; *banner* 14–14.5 mm. long, 6–6.5 mm. wide; *wings* $\pm$ 11 mm., the blades 6–6.5 mm. long, 1.4–1.6 mm. wide; *keel* 9.3–9.5 mm., the blades 4.5 mm. long, 2.5 mm. wide; *pod* ovate or broadly lanceolate in profile, moderately inflated, 1.6–2.6 cm. long, 9–12 mm. in diameter, rounded at base, contracted into a gently incurved beak 4–8 mm. long, the valves strigulose, mottled, becoming stiffly papery, the septum $\pm$ 4 mm. wide; *ovules* 12 (?)–20.—Collections: 1 (the typus).

Alkaline clay flats, probably $\pm$ 4000 feet, known only from the type-locality, in Esmeralda or possibly southern Mineral County, Nevada.—Not mapped.—May and June.

ASTRAGALUS LENTIGINOSUS var. SESQUIMETRALIS (Rydb.) Barneby in Leaflet West. Bot. 4: 116, Pl. II, figs. 36–38. 1945, based on *Cystium sesquimetricale* (1½-meter long, of the stems) Rydb. in N. Amer. Fl. 24: 414. 1929.—"Type collected at Soda Springs, Nevada, June 11, 1882, Shockley 278 (Gray Herbarium)."—Holotypus, GH! isotypi, ND, NY (fragm.), UC, US!

The name Soda Springs has been used freely and repeatedly to designate low alkaline areas in the southwestern deserts where water collects during winter or rises occasionally to the surface in salt pools or "hot pots." I have never identified the place of this name to which Shockley's label refers. I have presumed that it was not far distant from Candelaria, where Shockley was employed as a mining engineer, but repeated search in the few ostensibly suitable spots in this region has failed to rediscover the remarkable var. *sesquimetalis*. The plant should be very easily recognized by its long stems "creeping among grasses in moist soil," by the length of the internodes relative to the broad, short, almost sessile leaves, and by the short, headlike racemes of comparatively large flowers. The habit of growth and apparently the ecological requirements of var. *sesquimetalis* are closely similar to those of var. *albifolius*, from which it differs in the deeper calyx-tube, considerably longer petals, and a pod of stiffer texture contracted upward into an incurved and not gently decurved beak.

2891. *ASTRAGALUS LENTIGINOSUS* var. *KERNENSIS*

Slender perennial, strigulose with subappressed hairs up to 0.25–0.45 (0.5) mm. long, the herbage green or greenish-cinereous, the leaflets glabrous or nearly so above; *stems* prostrate or decumbent, 2.5–12 cm. long, the internodes all short, up to 1.8 cm. long but mostly less; *leaves* 1–5 cm. long, with short and slender petiole and (7) 11–19 remote or crowded, elliptic-oblancoolate, oval, or obovate, obtuse or emarginate, mostly conduplicate and recurved leaflets 1.5–7 mm. long; *peduncles* 0.6–2.5 cm. long; *racemes* loosely but shortly (2) 3–9-flowered, the axis 0.3–1.5 cm. long in fruit; *calyx* 4.1–5.3 mm. long, the tube cylindric or cylindro-campanulate, 3.5–4.6 mm. long, 1.7–2.5 mm. in diameter, the teeth 0.6–1.2 mm. long; *petals* whitish; *banner* 9.3–11.3 mm. long, 4.2–6 mm. wide; *wings* 8.6–10.8 mm., the blades 4.8–6.7 mm. long; *keel* 7.3–8.7 mm., the blades 3.5–4.5 mm. long; *pods* gathered into loose or compact, humistrate clusters, the bladdery-inflated, globose or very broadly and plumply ovoid or obovoid body 6–13 mm. long, 6–10 mm. in diameter, rounded or subcordate at base, truncate or obscurely umbilicate at apex where abruptly contracted into an erect, linear- or subulate-tubular, cusplike beak, the papery, subdiaphanous, pale green or stramineous, purple-mottled but ultimately brownish valves thinly and loosely strigulose, the complete septum 2–4 mm., the funicular flange 0.4–1.5 mm. wide; *ovules* (7) 10–18.—Collections: 8 (o); representative: *J. T. Howell* 26,756, 27,028 (CAS, RSA); *Purpus* 1871 (POM, UC); *Peirson* 2000 (CAS); *Twisselmann* 7833 (NY); *Jaeger* (from Charleston Peak) in 1926 (POM).

Dry gravelly or sandy slopes and flats, locally plentiful in two widely separated and narrowly restricted areas: among sagebrush and in lodgepole pine forest, on granite, 7800–8500 feet, Kern Plateau just west of the Sierra Crest in Tulare County, California (Volcano Creek; Templeton, Monache, and Troy meadows); and with bristlecone pine, on limestone, 10,000–10,500 feet, about the summit of Charleston Peak, Clark County, Nevada.—Map No. 128.—June and July.

ASTRAGALUS LENTIGINOSUS var. *KERNENSIS* (Jeps.) Barneby in Leaflet West. Bot. 4: 102. 1945, based on *A. kernensis* (of Kern River) Jeps., Man. Calif. 569. 1925.—“High Sierra Nevada of Tulare Co., Volcano Creek, 8200 ft. (Jepson 4930, type).”—Holotypus, labeled “Golden Trout Creek,” an earlier name for Volcano Creek, collected 2 July, 1912, UC-JEPS! —*Cystium kernense* (Jeps.) Rydb. in N. Amer. Fl. 24: 413. 1912.

Astragalus kernensis subsp. *charlestonensis* (of Charleston Peak) Clokey in Madroño 6: 218, Pl. 27, figs. k–o. 1942.—“... Charleston Peak. ... July 29, 1937, *Clokey* 5753 (type).—Holotypus, collected by Ira Clokey and Russell Bean, UC (herb. Clokey.)! isotypi, CAS, NY, PH, RM, RSA, TEX, WIS, WS!—*A. lentiginosus* var. *charlestonensis* (Clokey) Barneby in Leaflet West. Bot. 4: 101. 1945.

The var. *kernensis*, the most delicately fashioned of all forms of the protean *A. lentiginosus*, closely resembles the most slender phases of var. *ineptus* from high on the east slope of the Sierra Nevada. The flowers are usually somewhat fewer but essentially of the same form and size except for a slightly shorter calyx. The unique features of var. *kernensis* are the small size of the fruit and the modification of its beak into a narrow, tubular structure resembling a persistent style. However, the beak is sometimes a little broader at base than distally, subulate rather than linear in profile, and then a trifle compressed laterally, and although always much narrower than the triangular or deltoid beak elsewhere characteristic of *A. lentiginosus*, is not fundamentally different in structure.

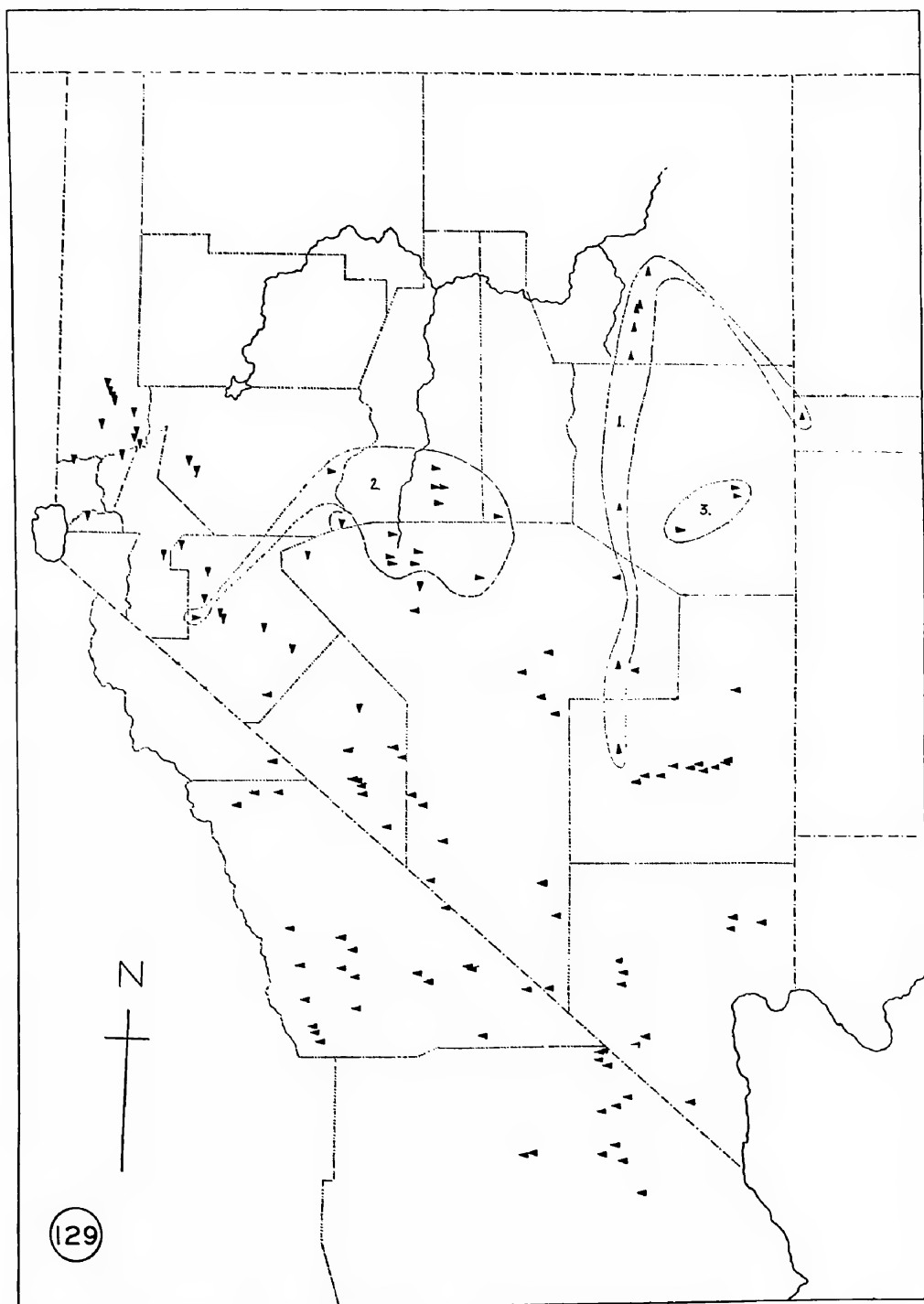
Since my revision of *A. lentiginosus* (1945) the Sierran populations of var. *kernensis* have become better known through admirable sets of specimens collected on the headwaters of the South Kern River by J. T. Howell. The variation now known to occur in a small area between Templeton and Monache meadows has fatally undermined, if not wholly demolished the supposed differential characters of var. *charlestonensis*, which I maintained as distinct on the basis of a larger pod and more numerous leaflets (1945, p. 77, in *clavate*). I now find that in the Sierra the leaflets range in number from 11 to 19, while the pod varies in length from

6 to 10 mm. On Charleston Peak the leaflets are of the same size and number and the pod varies from 6 to 13 mm. in length. The Nevadan plants do seem to differ slightly in the commonly wider septum (and correspondingly less deeply sulcate ventral suture) and in the slightly larger seeds. It might be added that the ovules are commonly 15–18 (but occasionally as few as 7) in the Sierra and only 10–15 on Charleston Peak. These, however, seem insubstantial characters to balance against the close essential similarities in all other respects, and var. *charlestonensis* is accordingly treated here as a minor variant.

The notable bicentric distribution of var. *kernensis* is bound to excite speculation as to its age and origin, particularly against the background of its species and section. Floristic relationships between the Sierra Nevada and the Charleston Range are few but can be traced feebly northwest through the White Mountains and directly westward, across the now impassable gap of the Mohave Desert, through the San Bernardino and San Gabriel Mountains. Interestingly enough, each of these mountain masses is occupied by an endemic form of *A. lentiginosus*, the White (and Inyo) Mountains by var. *semotus*, the east slope of the Sierra escarpment by var. *ineptus*, and the Transverse Ranges by vars. *sierrae* and *antonius* respectively. There can be no doubt that all are very closely related to var. *kernensis*, and the question arises as to whether a parallel modification has not arisen separately in the two areas; but the number of coincidences required cannot appear likely to the rational mind. Granted that the populations of var. *kernensis* in its two foci of distribution are monophyletic in origin, and that neither stems from a chance introduction (which seems to the highest degree improbable), it must be assumed that the ancestral stock was much more widely distributed formerly than it is today. In some relatively moist and cool periods during the Pleistocene var. *kernensis* could have migrated across or around the north periphery of what is now the Mohave Desert and become confined to its present refugia as aridity increased. Yet it is puzzling that ecologically suitable refuges adjacent to the Mohave are occupied today by other races of *A. lentiginosus*. Did var. *kernensis* never reach these bordering ranges? Did it reach them and there become assimilated or submerged by a later invasion of a younger and more vigorous offshoot of its species? I have no answers to these questions. The history of var. *kernensis* must be more complex and probably reaches back further into the past than that of the other forms of *A. lentiginosus* to which it is most closely allied.

289m. ASTRAGALUS LENTIGINOSUS var. PLATYPHYLLIDIUS

Perennial, resembling var. *lentiginosus* in growth-habit but commonly coarser, thinly strigulose with subappressed hairs up to 0.3–0.55 mm. long, the stems and herbage subglabrous, the thick-textured, green or subglaucescent leaflets glabrous above, sometimes ciliate, the inflorescence commonly black-strigulose; *stems* (0.7) 1–3 (3.5) dm. long, stramineous or pallid, floriferous from near or below the middle; *leaves* (4) 5–11 cm. long, with (7) 11–17 (19) broadly obovate-cuneate, elliptic, or suborbicular, obtuse, retuse, truncate and apiculate, or rarely rhombic-elliptic and acute leaflets (4) 7–20 mm. long; *peduncles* 1–5 cm. long; *racemes* shortly but loosely (5) 7–15-flowered, the axis little elongating, 1–3.5 cm. long in fruit; *calyx* (8) 8.5–12.5 mm. long, the cylindric or deeply campanulate tube (5) 5.5–8 (9) mm. long, 2.3–4 (4.4) mm. in diameter, the teeth 2.4–5 mm. long; *petals* whitish, the keel- and sometimes the wing-tips tinged with pink or lilac; *banner* broadly rhombic-oblongate or -elliptic, (12.6) 14–21.4 mm. long, (6.1) 6.6–11.5 mm. wide; *wings* (11.6) 12.6–17.3 mm., the blades 6.7–10.4 mm. long; *keel* (shorter, or exceptionally a trifle longer than the wings) 11–15 mm. long, the blades (5.1) 5.7–7.4 mm. long, (2.2) 2.4–3.5 mm. wide; *pod* very variable in length, outline, and curvature, (1.3) 1.5–4 (4.8) cm. long, 7–14 mm. in diameter, the body strongly or little inflated, plumply ovoid or narrowly lance-ellipsoid, rounded or cuneately tapering at base, contracted or acuminate tapering distally into a deltoid or lance-acuminate, unilocular beak 5–15 mm. long, the whole nearly straight or lunately to hamately incurved through up to $\frac{3}{4}$ -circle, openly sulcate along either or both sutures, the more or less fleshy, pale green or purple-speckled (exceptionally mottled), glabrous or less often minutely strigulose valves becoming leathery or stiffly papery, stramineous or brownish, the complete or nearly complete septum 2.2–5 (7) mm., the funicular flange (0.5) 0.7–1.3 mm. wide; *ovules* (21) 24–32 (38).—Collections: 55 (viii); rep-



Map No. 129. Nevada and parts of adjoining states. Range (in part) of *A. lentiginos*: ◄ var. *Fremontii*; ◄ var. *Kennedyi*; ◄ (circled, No. 1) var. *scorpionis*; ◄ (circled, No. 2) var. *toyabensis*; ◄ (circled, No. 3) var. *latus*.

representative: *Cronquist* 6267 (ID, NY, RSA, SMU, WS), 7022 (ID, NY, RSA); *Maguire & Holmgren* 26,301, 26,429 (NY, RSA, WS); *Payson & Payson* 1703 (GH, NY), 2657 (F, NY, POM, UC); *A. Nelson* 4842 (NY, POM); *Heller* 9250 (F, NY); *Ripley & Barneby* 5744 (CAS, NY, RSA).

Arid plains, hillsides, and valley floors, commonly on basalt and associated with sagebrush, sometimes in alkaline alluvia or sand derived from shale or sandstone, 2250–6000, and at its eastern limit up to 6700 feet, widespread and locally plentiful over most of transmontane Oregon, from John Day Valley southward into northeastern California, extreme northern Nevada, and east in scattered stations around the edge of the Snake River Plains in southern Idaho to the Bear River and upper Green River Basin in southwestern Wyoming, the Weber River in adjoining Utah, and the Yampa Valley in extreme northwestern Colorado.—Map No. 129.—May to July.

ASTRAGALUS LENTIGINOSUS var. *PLATYPHYLLIDIUS* (Rydb.) Peck, Man. Ore. 449. 1940, & in Madroño 6: 135. 1941, based on *Cystium platyphyllidium* (with flat leaflets) Rydb. in N. Amer. Fl. 24: 410. 1929.—“Type collected on Pine Creek, Gilliam county, Oregon, June 7, 1891, *J. B. Leiber* 171 . . .”—Holotypus, NY! isotypi, GH, ORE, US!

Cystium Merrillii (Elmer Drew Merrill, 1876–1956) Rydb. in N. Amer. Fl. 24: 410. 1929.—“Type collected on Leucite Hills, Wyoming, June 18, 1901, *Merrill & Wilcox* 680 . . .”—Holotypus, NY! isotypi, GH, US! *Astragalus Merrillii* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937.

Cystium cornutum (horned, of the pod) Rydb. in N. Amer. Fl. 24: 412. 1929.—“Type collected at Muddy Station, John Day Valley, May 13, 1885, *T. Howell* . . .”—Holotypus, NY! isotypi F, ORE, P, UC, and (dated May 14, 1885) WS!—*A. lentiginosus* var. *cornutus* (Rydb.) Peck, Man. Ore. 449. 1940.

The var. *platyphyllidius* might be visualized as a coarsened version of var. *lentiginosus* or var. *salinus*, differing in its longer (commonly much longer) calyx and petals and its often larger, always thicker-walled fruits which dry out to a leathery or stiffly papery texture. It stands in a morphological gap between the group, described up to this point, of varieties with small, mostly whitish flowers and the next following group of varieties which are similar in flower-size but differ in their purple petals and more southern range. The variety is polymorphic, as described and illustrated in more detail elsewhere (Barneby, 1945, p. 104–6), and in parts of its range there are suggestions of racial differentiation although no real discontinuities in variation. The longest flowers and longest, least-swollen pods are found, both together and separately, along the north slope of the Blue Mountain system draining to the Columbia. The type of *Cystium platyphyllidium* and *C. cornutum* were both from this region and represent respectively the glabrous-fruited and rarer puberulent-fruited phases which are known to occur occasionally in the same population. South of the Blue Mountains in Oregon and states adjoining to the south and east, var. *platyphyllidius* is usually a little smaller-flowered and its pod, which is also a little shorter, varies from little to greatly inflated. In all this region the variety is confined to volcanic soils and is sympatric with var. *salinus*, var. *lentiginosus*, or both, and is sometimes difficult to distinguish from the so-called “*carinatus*” form of the latter. I now feel satisfied that *Leiber* 2110 from Malheur County, Oregon, which I hesitantly referred to var. *carinatus* in my revision (1945, p. 83) is best interpreted as an aberrant state of var. *platyphyllidius* with exserted keel-petals. No other collection quite like it has been seen. East of the region covered so far, in the drainage of the Green, Bear, and Yampa Rivers, the variety reappears on sedimentary (or rarely granitic) bedrock and bears flowers of moderate size and a pod nearly always inflated and of slightly less firm texture. Possibly this phase (= *C. Merrillii*) should be detached from var. *platyphyllidius*, but I have found no practical method of separating it, for the pods of plants originating so far apart as Lassen County, California, and Moffat County, Colorado, are virtually indistinguishable.

289n. *ASTRAGALUS LENTIGINOSUS* var. *TOYABENSIS*

Diffuse or decumbent, the slender stems 1–3 dm. long, the herbage green, thinly strigulose with subappressed hairs up to 0.35–0.6 mm. long, the leaflets glabrous above and often nearly so beneath; leaves 3–13 (16) cm. long, with slender petioles and (7) 15–25 oval-obovate or broadly oblanceolate, obtuse and mucronulate or truncate, thin-textured, or (in exposed places) narrowly elliptic-oblance-

olate, acute or subacute, thicker-textured, mostly flat leaflets (2) 6–16 (21) mm. long; *peduncles* usually very slender, 1.5–4.5 (6.5) cm. long; *racemes* 7–18-flowered, the fruiting axis 1–2.5 (5) cm. long; *calyx* (6.2) 6.7–10 mm., the tube 5–6.5 mm. long, 2.4–2.8 mm. in diameter, the subulate teeth (1.2) 1.6–3.5 (4) mm. long; *petals* normally pink-purple, rarely whitish with pale pink keel- and wing-tips; *banner* 12.6–17 mm. long, 5.6–8 mm. wide; *wings* (11) 11.8–13.8 (15) mm., the blades 6.3–8.3 mm. long; *keel* (9) 9.4–12 mm. long, the blades 4.4–6 mm. long; *pod* narrowly to broadly ovoid-acuminate, more or less strongly inflated, 0.8–2 cm. long, 4–11 mm. in diameter, the incurved, unilocular, triangular-acuminate beak (3) 4–11 mm. long, the papery, usually mottled, glabrous or exceptionally puberulent valves becoming papery and stramineous; *ovules* 13–20.—Collections: 15 (o); representative: *Hitchcock & Martin* 5599 (NA, NY, POM, WTU), 5619 (DS, NA, NY, POM, WS); *Maguire & Holmgren* 10,553 (NY, RSA), 25,753 (NY, RSA), 25,792 (CAS, NY, RSA, TEX, WS), 25,898, 25,960 (NY, RSA, WS); *Archer* 7115 (NA, NY).

Dry stony hillsides among sagebrush, ascending thence to open treeless crests within and rarely above the timber belt, occasional in cool loamy soils among aspens, mostly on igneous bedrock, (6000) 8000–11,300 feet, locally frequent in the Wassuk, Toiyabe, and Monitor Ranges, westcentral Nevada.—Map No. 130.—June to August.

ASTRAGALUS LENTIGINOSUS var. *TOYABENSIS* (of the Toyabe or better Toiyabe Mountains) Barneby in Leaf. West. Bot. 4: 106, Pl. III, figs. 1–4, and Pl. I, figs. 19, 21, 22 (as var. *scorpionis*). 1945.—“Toyabe Mountains, Nevada, *Sereno Watson* No. 253...”—Holotypus, collected at “6000 ft.” but probably higher, in July, 1868, GH! isotypi, NY, US!

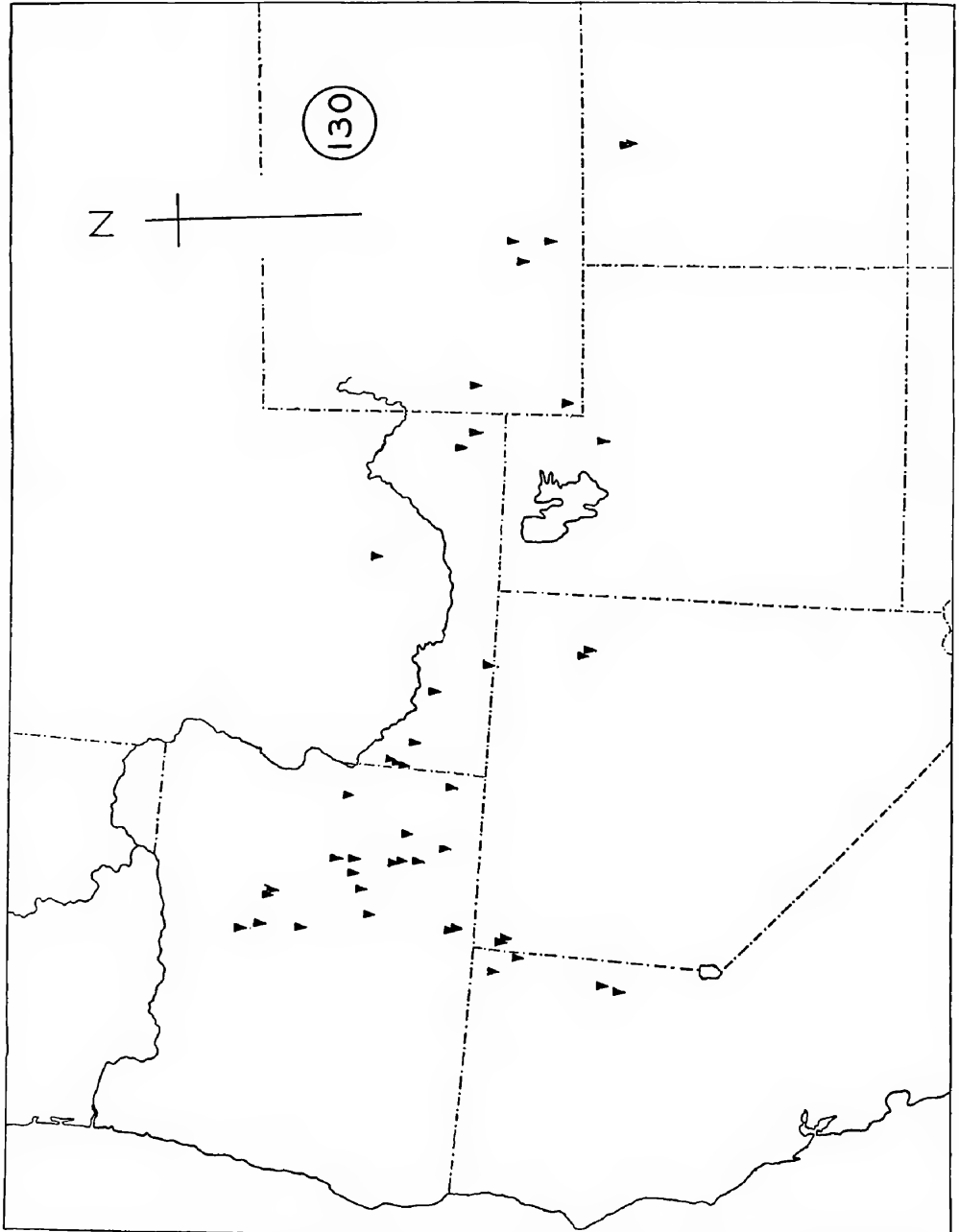
The var. *toyabensis* is the first of a series of varieties characterized by flowers of moderate or large size and ordinarily bright purple coloring which are gathered into short racemes elongating little or not at all in fruit. It is evidently closest to var. *scorpionis* of the preceding group, differing chiefly in its longer flower, with banner 12.6–17 mm., not 8.5–12.2 mm. long. Ordinarily a montane plant, it descends occasionally into the foothills as low as 6000 feet where it enters the habitat of, and apparently passes into, var. *araneosus*, a form which differs ideally in its leathery or at least much more stiffly papery pod.

At the time of my revision of the freckled milk-vetch (1945) the material available from the mountains of Nevada was inadequate to illustrate the racial realities, and consequently I made several blunders which seem inexcusable today. In the first place I described the typus of var. *toyabensis* as white-flowered, almost certainly an error, and compared it with var. *platyphyllidius*, with which it has no especially close ties. From the ample sets of specimens collected by Maguire & Holmgren, J. & M. Linsdale, and others, I have learned that the common montane variety of *A. lentiginosus* in the volcanic mountains of central and westcentral Nevada is at least normally purple-flowered. In general aspect it resembles the smaller-flowered var. *scorpionis* endemic to the limestone ranges of eastern Nevada and adjoining Utah, which is dispersed over an almost equally great vertical range and varies in parallel fashion so far as stature and the pod's inflation and curvature are concerned. At great elevations the plants of both varieties become dwarfed and the pod tends to become little swollen; I wrongly associated this phase of var. *toyabensis* (op. cit., p. 85) with the fragmentary typus of var. *scorpionis*, now believed to be identical with what is there described as var. *tremuletorum*. In the timber belt var. *toyabensis* becomes a greener, lusher plant, sometimes found in fertile soil among aspens, and I mistook one specimen from this environment for var. *tremuletorum* (op. cit., p. 86), by unhappy accident the specimen that suggested the varietal epithet.

289o. *ASTRAGALUS LENTIGINOSUS* var. *LATUS*

Low, loosely tufted, with a woody, suffruticulose (sometimes partly buried) caudex, the diffuse stems about 0.5–1.7 dm. long, the herbage green or subglaucescent, glabrous or nearly so, the few scattered hairs on the leaf-rachis and inflorescence appressed, up to 0.3–0.5 mm. long; *leaves* petioled, (4) 6–13 cm. long, with 11–17 (23) broadly obovate, ovate, or broadly oblanceolate, shallowly notched or obtuse, flat, rather thick-textured leaflets (4) 6–15 mm. long; *peduncles*

1.5–6 cm. long, much shorter than the leaves; *racemes* loosely but shortly 5–12 (18)-flowered, the axis 0.7–2 (4) cm. long in fruit; *calyx* (6.5) 7–12.5 mm. long, black-strigulose, the tube (4.5) 5.6–8.2 mm. long, (2.3) 2.6–3.4 mm. in diameter, the teeth (1.4) 2–4 mm. long; *petals* pink-purple; *banner* (11.3) 15–19 mm. long, (5.3) 6.5–8.2 mm. wide; *wings* (10.5) 13.4–16.7 mm., the claws (5.2) 6.6–9.3 mm., the blades (5.9) 7.8–8.7 mm. long; *keel* (9.2) 11.5–14.8 mm., the claws (5) 6.5–9 mm., the blades (4.5) 5.6–6.5 mm. long, 2.3–3 mm.



Map No. 130. Parts of western United States. Range of *A. lentiginosus* var. *platyphyllidius*.

wide; *pod* plumply ovoid or subglobose, 1–2.5 cm. long, about 0.7–1.6 cm. in diameter, contracted at apex into an erect or incurved, fully bilocular beak 0.25–0.5 cm. long, the green but red-mottled, glabrous valves becoming leathery, stramineous, the septum broad and complete; *ovules* 22–28, rarely 12–14.—Collections: 5 (i); representative: *Jones* (from Aurum) in May, 1893 (F, GH, NY, POM, UC) and July, 1893 (GH, NY, POM); *Ripley & Barneby* 4020 (CAS, NY, RSA).

Open gravelly slopes in the timber belt, 7500–9500 feet, on limestone, forming colonies but apparently local, known only from the Schell Creek and Egan Ranges, White Pine County, Nevada.—Map No. 129.—May to July.

ASTRAGALUS LENTIGINOSUS var. *LATUS* (Jones) Jones, Rev. Astrag. 125, Pl. 24. 1923, based on *A. diphysus* var. *latus* (broad, presumably of the *pod*) Jones in Zoë 3: 287. 1893 (Jan., according to original cover, "1892" on title-page).—"Schell Creek Range, Nevada, May, on the hillsides."—Holotypus, collected by Jones at Aurum, White Pine County, in 1891, POM!—*A. latus* (Jones) Jones in Zoë 4: 272. 1894. *Cystium latum* (Jones) Rydb. in N. Amer. Fl. 24: 415. 1929.

As it occurs in the Schell Creek Range, at Aurum and Schellbourne, var. *latus* is a rather handsome plant, notable for the shortness of the stems and peduncles in relation to the long, narrow flowers and swollen, humistrate pods. The plants known to me from Ward Mountain in the Egan Range have stems mostly longer and at the same time substantially smaller flowers and pods. In general appearance they resemble var. *toyabensis* of the volcanic and granitic mountains of central Nevada, but the *pod* is essentially that of var. *latus*, with coriaceous walls and a broad septum produced into the apex of the beak. This last feature is the variety's strongest differential character. It will be interesting to learn of new stations for what seems at present to be one of the most narrowly confined forms of the freckled milk-vetch. It is to be sought especially in the Snake Range and on Troy Peak, from which there is yet no montane form of *A. lentiginosus*.

289p. *ASTRAGALUS LENTIGINOSUS* var. *IDRIENSIS*

Diffuse perennial, the stems decumbent with ascending tips, (1) 1.5–4 dm. long, the herbage green or greenish-cinereous, thinly to quite densely strigulose or subpilosulous with subappressed and (especially upward) some or many ascending hairs up to 0.5–1 (1.2) mm. long, the leaflets glabrous above; *leaves* (2) 3–11 cm. long, the upper ones subsessile, with (7) 17–27 (29) oval-obovate, obovate-cuneate, or broadly oblanceolate, truncate or emarginate, flat or loosely folded leaflets (2) 3–15 (18) mm. long; *peduncles* (1.5) 3–6 cm. long, shorter, as long, or rarely longer than the leaf; *racemes* 7–20-flowered, the axis (0.5) 1–4 cm. long in fruit; *calyx* (5) 6.2–11 mm. long, the cylindric or cylindro-campanulate tube (4.2) 4.7–7.2 mm. long, 2.5–3.8 mm. in diameter, the teeth (0.5) 1.3–3.4 mm. long; *petals* pink-purple, brilliant or pale, drying violet or whitish; *banner* (12) 14–19 (20) mm. long, 6–9 (9.8) mm. wide; *wings* (10) 11.8–16.1 mm., the blades 6.7–9.8 (10.7) mm. long; *keel* (9) 10.5–14 mm., the blades 5.5–7.1 mm. long; *pod* obliquely ovoid or lunately half-ovoid, greatly or little inflated, 1.2–3 cm. long, 5–16 mm. in diameter, the more or less incurved, triangular-acuminate, cuspidate, unilocular beak 3–10 mm. long, the ventral suture nearly straight to gently convex-arched, prominent in little-inflated pods and depressed and lying in a shallow groove in much-inflated ones, the green, commonly red-mottled, somewhat fleshy, white- or rarely black-strigulose valves becoming leathery or stiffly papery, the septum 2.5–5.5 mm. wide; *ovules* 21–30.—Collections: 24 (i); representative: *H. K. Sharsmith* 1901 (DS, WS); *Stebbins & al.* 5055 (CAS); *Twisselmann* 1081, 1140 (CAS); *Munz* 6968 (NY, POM, UC), 8917 (POM), 16,298 (CAS, NY); *Epling & Wheeler* 1818 (POM, UC).

Dry grassy hillsides, canyon floors and benches, sometimes on shale or sandstone outcrops, commonly in arid grassland with Douglas oak, sometimes with

digger pine or among sagebrush, 2100–4000 feet, locally plentiful in the mountains around the head of San Joaquin Valley, California (Tehachapi Mountains; Mount Piños), west to the San Rafael Mountains, Santa Barbara County, and north in scattered stations through the South Coast Ranges (Temblor Range, western Kern and adjoining San Luis Obispo Counties; San Carlos Range, San Benito County; Santa Lucia Mountains, Monterey County) to the Mount Hamilton Range, Santa Clara County.—Map No. 128.—April to June.

ASTRAGALUS LENTIGINOSUS var. *IDRIENSIS* (of New Idria) Jones, Contrib. West. Bot. 10: 63. 1902 ("*Idriensis*").—"... collected at New Idria, California, by Miss Eastwood."—Holotypus, collected in 1893, POM! isotypi, CAS, UC!—*Cystium idriense* (Jones) Rydb. in N. Amer. Fl. 24: 414. 1929. *A. idriensis* (Jones) Abrams, Ill. Fl. Pac. St. 2: 599. 1944.

Cystium tehachapiense (of Tehachapi) Rydb. in N. Amer. Fl. 24: 414. 1929.—"Type collected at Tehachapi, Kern County, California, May 5, 1905, *Heller 7833*..."—Holotypus, NY! isotypi, NY, PH, US, WIS!—*A. tehachapiensis* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937 ("*tehachapiensis*"). *A. lentiginosus* var. *tehachapiensis* (Rydb.) Barneby in Leaflet West. Bot. 4: 108. 1945.

Astragalus lentiginosus var. *caesariatus* (long- and dark-hairy) Barneby in Proc. Calif. Acad. Sci. IV, 25: 161, Pl. 17, figs. 29, 30. 1944.—"CALIFORNIA... Temblor Range above McKittrick, Kern Co., alt. 2900 ft., 13 April... *Ripley & Barneby 3243*..."—Holotypus, collected in 1941, CAS! isotypi, POM, RSA!

The var. *idriensis* is the one form of *A. lentiginosus* with shortly racemose, purple flowers which is native in the South Coast Ranges. There it occupies a belt mostly lying between two and four thousand feet. The only other purple-flowered freckled milk-vetch known to occur west of the mountains in California is var. *variabilis*, found in a few stations on the valley floor near Bakersfield, where it is probably a recent immigrant; its fruiting raceme is loose and elongate as in var. *nigricalycis*, the common cismontane form of the species which is easily distinguished by its villousulous vesture and loosely racemose, yellow flowers. Around the head of San Joaquin Valley the flowers of var. *idriensis* tend to be relatively small and pale and the calyx-teeth mostly shorter than in the Coast Ranges; this phase rather closely approaches var. *sierrae* (of the San Bernardino Mountains), probably its nearest relative.

Arguments in favor of amalgamating into one polymorphic entity the three varieties *idriensis*, *caesariatus*, and *tehachapiensis*, which I maintained as distinct in 1945, have been presented elsewhere (1958, p. 135). Variation in the resulting complex is inconveniently great, but I have little doubt that the more inclusive var. *idriensis* corresponds as well with a biological reality as it does with the known patterns of plant-dispersal in the South Coast Ranges. The var. *caesariatus* was based on an exceptionally large-flowered phase but scarcely differs otherwise from small-flowered plants collected subsequently in the Temblor Range. The typus of var. *idriensis* was likewise an unusual plant with peduncles remarkably long in relation to the short leaves (and hence a peculiar facies), unusually short calyx-teeth, and short, little-swollen pod. Approximate topotypes have a much more normal appearance and pods inflated as usual in the variety. Densely and sometimes loosely pubescent plants from the slopes of Mount Piños, which combine the diffuse growth-habit and short racemes of var. *idriensis* with ochroleucous flowers, have been singled out (Barneby, 1945, p. 110) as possible evidence of introgression between var. *idriensis* and var. *nigricalycis*; they are perhaps as plausibly interpreted as individual and independent minor mutants, but more evidence is needed on this point (cf. *Abrams & McGregor 204*, GH, NY; *Ripley & Barneby 4086*, RSA).

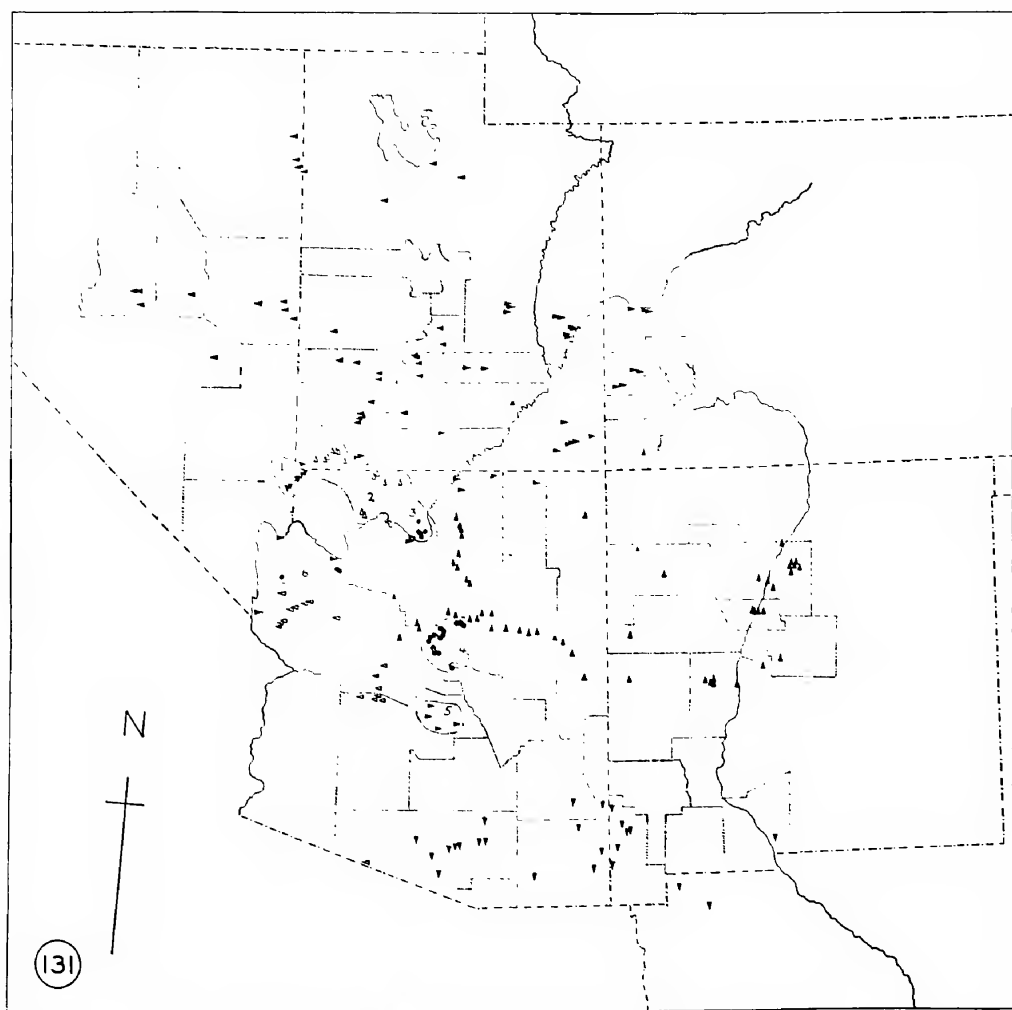
289q. *ASTRAGALUS LENTIGINOSUS* var. *OROPEDII*

Diffuse perennial, appearing glabrous, the herbage green or subglaucouscent, the leaflets beset with a few scattered, subappressed hairs up to 0.4–0.7 mm. long on the lower side, the margins, or the midrib, glabrous above; *stems* decumbent or weakly ascending, glabrous or nearly so, (1) 2–4 dm. long, flexuous or zigzag in age; *leaves* 5–14 cm. long, the upper ones subsessile, with 15–21 (25) broadly oblong-elliptic, ovate-oblong, or suborbicular, flat leaflets 5–20 (25) mm. long; *peduncles* (2) 3–8.5 cm. long, shorter than or subequaling the leaf; *racemes* shortly (8) 10–25-flowered, the axis little elongating, 1.5–4 (5) cm. long in fruit; *calyx* 7.5–10.8 mm. long, thinly black- and white-strigulose, the tube (4.5) 5–7.5 mm., the teeth (2.5) 3–5 mm. long; *petals* purple; *banner* (12.5) 13.2–20

mm. long; *wings* 12–18.2 mm., the blades 6.5–10.2 mm. long; *keel* 11–16.1 mm., the blades 4.8–7.4 mm. long; *pod* obliquely ovoid or half-ovoid, $\pm$ strongly inflated, 1.3–2.5 cm. long, 6.5–14 mm. in diameter, sulcate along both sutures, contracted distally into a triangular-acuminate, laterally compressed, unilocular beak 5–8 mm. long, the valves firmly papery, mottled, glabrous, inflexed as a complete or semicomplete septum 2.8–3.5 mm. wide; *ovules* 20–33.—Collections: 7 (o); representative: *Eastwood & Howell* 930 (CAS, POM); *Peirson* 7428 (CAS); *Collom* 2206 (ARIZ, CAS).

Openings in yellow pine forest, 7000–8000 feet, locally plentiful but apparently confined to the Kaibab Plateau, especially the North Rim and upper levels of the north wall of the Grand Canyon of the Colorado River, Coconino County, Arizona.—Map No. 131.—June to September.

ASTRAGALUS LENTIGINOSUS var. *OROPEDII* (of the plateau) Barneby in Leaf. West. Bot. 4: 135. 1945.—“*Type*. Kaibab Trail to Roaring Springs, Grand Canyon National Park, Coconino



Map No. 131. Utah, Arizona, New Mexico, and parts of adjoining states. Range (in part) of *A. lentiginosus*: $\blacktriangle$ var. *diphyssus*; $\blacktriangledown$ var. *australis*; $\blacklozenge$ var. *araneosus*; $\blacklozenge$ var. *yuccanus*; $\blacklozenge$ var. *palans*; $\blacklozenge$ (circled, No. 1) var. *stramineus*; $\blacklozenge$ (circled, No. 2) var. *vitreus*; $\bullet$ (circled, No. 3) var. *oropedii*; $\bullet$ (circled, No. 4) var. *Wilsonii*; $\blacklozenge$ (circled, No. 5) var. *maricopae*; $\bullet$ (circled, No. 6) var. *ambiguus*.

County, Arizona, 22 September 1938, fruct., *Eastwood & Howell No. 7064* . . . Also *ibid.*, 23 June 1933, flor., *Eastwood & Howell No. 1054* . . ."—Cotypi, CAS!

The var. *oropedii* was originally described as combining features of var. *Wilsonii*, var. *palans*, and var. *diphysus*, having the glabrous, subglaucous herbage and diffuse habit of the first, the individual flower of the second, and the inflated, obliquely ovoid pod of the last. Fruiting specimens are most likely to be compared or confused with var. *diphysus* but may be distinguished by the long-toothed calyx and the pod of perceptibly thinner texture. The variety is more easily separated from var. *vitreus*, the freckled milk-vetch prevalent on the north slope of the Kaibab at lower altitudes, by its larger flowers and compact racemes. The only other form of *A. lentiginosus* known to occur in the Grand Canyon is var. *palans*, common on the South Rim, and this is easily distinguished from var. *oropedii* by its uninflated pod of slender outline.

289r. ASTRAGALUS LENTIGINOSUS var. CHARTACEUS

Perennial, thinly strigulose with subappressed hairs, the herbage bicolored, the rather thick-textured leaflets yellowish-green and glabrous above; *stems* rather slender, prostrate or weakly ascending, 1–1.5 dm. long, flexuous distally; *leaves* 3–6 cm. long, with 9–15 broadly obovate-emarginate or obcordate, flat leaflets 6–12 mm. long; *peduncles* 1–2 cm. long, much shorter than the leaf; *racemes* shortly 5–8-flowered, the axis not elongating, less than 1 cm. long in fruit; *flowers* known only from withered fragments; *calyx* $\pm$ 6.5 mm., the teeth $\pm$ 2 mm. long; *banner* $\pm$ 16 mm., wings $\pm$ 14.5 mm., keel $\pm$ 13 mm. long; *pod* broadly lance- or obliquely ovoid-acuminate, moderately inflated, 2–2.8 cm. long, 8–13 mm. in diameter, the incurved, lance-acuminate, unilocular beak 5–8 mm. long, the glabrous valves becoming stiffly papery, stramineous.—Collections: 1 (the *typus*).

Clay flats, $\pm$ 5500 feet, apparently rare and local, known only from the type collection in the San Pitch Valley, Sanpete County, Utah.—Not mapped.—May to early July.

ASTRAGALUS LENTIGINOSUS var. CHARTACEUS (papery) Jones in Proc. Calif. Acad. Sci. II, 5: 673. 1895.—"No. 5627m. July 13, 1894, Ephraim, Utah, in clay, 6000' alt."—Holotypus (dated July 11), POM!

Until adequate material of var. *chartaceus*, including fresh young flowers, becomes available, the status of the variety and its relationships within the species-complex must remain quite doubtful. Jones (1923, p. 125) listed it as a synonym of var. *diphysus*, regarding it, however, as a form intergradient to the Nevadan var. *latus*. It resembles the latter in its very short peduncles, but differs in the strongly beaked, apically unilocular pod. It is easily distinguished from var. *salinus*, to which Rydberg (1929, p. 411) reduced it, by its substantially larger flower. It appears to differ from the very similar but allopatric var. *platyphyllidius* in its purple flower, but as the petals are known only from withered fragments, this difference may not be a real one. The sympatric, purple-flowered var. *araneosus* has a very similar pod but differs in aspect because of the more numerous leaflets and flowers.

289s. ASTRAGALUS LENTIGINOSUS var. ARANEOSUS

Perennial, low but relatively coarse, strigulose with straight, usually appressed hairs up to 0.4–0.7 mm. long, commonly thinly so, the herbage green, the leaflets glabrous above or on both sides, ciliate, more rarely thinly pubescent on both sides and greenish-cinereous; *stems* several or numerous, diffuse and incurved-ascending, 1–2.5 (3.5) dm. long, often red-tinged, simple, floriferous upward from near or below the middle; *leaves* (2.5) 4–11 cm. long, with 15–23 elliptic-oblongate, broadly oblong-oblongate, or obovate, obtuse or emarginate, flat or loosely folded leaflets (3) 5–17 (20) mm. long; *peduncles* stout, 2.5–6 (7.5) cm. long; *racemes* 10–20-flowered, the axis 1.5–4 (5.5) cm. long in fruit; *calyx* (6.2) 7.5–10.5 mm., the tube (4.6) 5.2–6.7 mm. long, (2.4) 2.8–3.4 mm. in diameter, the teeth 1.4–3.8 mm. long; *petals* bright pink-purple, the banner with a pale, striate eye; *banner* (12.5) 15–18.2 mm. long, 7–10.4 mm. wide; *wings* (10.3)

12.7–16 mm., the claws (4.5) 6.6–8 mm., the blades (6.5) 7–9 mm. long; *keel* (9) 10.5–15 mm. long, the claws (4.6) 6.5–8.1 mm., the blades (4.6) 6–7 mm. long, (2.3) 2.7–3.1 mm. wide; *pod* very obliquely ovate-acuminate in profile, 1.5–3 (4) cm. long, (7) 9–15 mm. in diameter, almost always very strongly incurved, the moderately or greatly inflated body tapering or abruptly contracted into an incurved, unilocular beak 6–15 mm. long, the green, often red-mottled, glabrous or rarely puberulent valves becoming stiffly papery or almost leathery, the complete septum about 3–5.5 mm., the funicular flange 0.8–2 mm. wide; *ovules* 24–34 (38).—Collections: 39 (viii); representative: *Maguire & Blood* 4411 (F, POM, UC); *Eastwood & Howell* 622 (CAS, NY, POM), 9340 (CAS, RSA, WS); *Ripley & Barneby* 3575 (CAS, RSA); *C. L. Hitchcock* 2957 (F, WS, WTU); *Jones* (from Detroit, Utah) in 1891 (POM, UC).

Gravelly banks, washes, gullied foothills, and valley floors, with sagebrush or juniper, commonly but not exclusively in alkaline soils, apparently most abundant on calcareous bedrock but not confined thereto, 4700–7200 feet, forming colonies and sometimes locally abundant, widespread over western Utah from Salt Lake and Wasatch Counties south to Iron County, and ascending the Sevier Valley into Piute County, west across the Salt Lake and Sevier Deserts into the valleys of northeastern and central Nevada, there apparently intergrading with vars. *Fremontii*, *Kennedyi*, and *toyabensis*.—Map No. 131.—May to July.

ASTRAGALUS LENTIGINOSUS var. ARANEOSUS (Sheld.) Barneby in Leaf. West. Bot. 4: 112, Pl. III, figs. 11–14. 1945, based on *A. araneosus* (cobwebby, in allusion to the filaments within the pod) Sheld. in Minn. Bot. Stud. 1: 170. 1894.—“Collected near Frisco, Utah, June, 1880, by M. E. Jones; also at Muddy station, John Day valley, Oregon, May, 1885, by Thomas Howell.”—Lectotypus (Barneby, l.c.), *Jones* 1807, MINN! isotypi, F, GH, NY, ORE, POM, RM, US! (the paratypus = var. *platyphyllidius*).—*A. palans* var. *araneosus* (Sheld.) Jones in Proc. Calif. Acad. Sci. II, 5: 675. 1895. *Cystium araneosum* (Sheld.) Rydb. in Bull. Torr. Club 40: 50. 1913.

The var. *araneosus* is the commonest freckled milk-vetch dispersed over the bed of former Lake Bonneville, whence it extends westward into the mountain valleys of eastern and central Nevada and southward some distance up the canyon of the Sevier River. Over the greater part of its area it is the only representative of the species with purple flowers of good size and pods of leathery or stiffly papery texture, features shared, however, by the rare var. *latus* (which differs in its subglobose pod with very short, bilocular beak) and by the allopatric but very closely related var. *diphysus*. The latter is rather artificially separated from var. *araneosus* by pronounced tendencies in variation rather than by any one differential character: the plants are more often glabrous or nearly so, while the pod is less oblique in profile with a shorter and less strongly incurved beak. At the time of my revision of *A. lentiginosus* (1945) var. *diphysus* had not been found north or west of the Colorado River in northern Arizona. It has since been traced to the Henry Mountains in southern Utah, and it is possible that the two varieties will prove to be geographically as well as morphologically confluent.

The var. *araneosus* is no less variable than other widespread forms of its species. The pod varies greatly in the degree of inflation and in the least-swollen state nearly approaches that of var. *palans* (see discussion below). Ordinarily the flowers are quite large and handsome, with calyx about 7.5–10.5 mm., banner 15–18 mm., and keel well over 10 and up to 15 mm. long; but at the southwest edge of its range in central Nevada are encountered (mostly on granitic or volcanic rock-formations) populations with rather small flowers (the calyx about 6.2–7 mm., banner 12.5–15 mm., and keel about 9–10 mm. long) combined now with short and now with moderately elongating raceme-axis, and pods intermediate in texture between stiffly papery and papery-membranous. Plants of this nature are in various degrees intergradient between var. *araneosus* as ideally conceived and the vicariant vars. *Fremontii*, *Kennedyi* (both long-racemose, the former even smaller-flowered), and *toyabensis* (short-racemose but with thin-papery pod). Cf. *Ripley & Barneby* 3652, 4427, 6234, from Nye and Eureka Counties (RSA).

289t. ASTRAGALUS LENTIGINOSUS var. DIPHYsus

Perennial, usually stout and coarse, the glabrous stems incurved-ascending in low clumps, the herbage yellowish-green or dark green, thinly strigulose or

strigulose-villosulous with mostly straight hairs up to 0.4–0.75 mm. long, the leaflets glabrous above or on both sides; *stems* simple or branched at base, (1) 1.5–3.5 (4) dm. long; *leaves* 3–10 (14) cm. long, with (11) 15–21 (23) oblong-ob lanceolate, obovate, rhombic-obovate, elliptic, or ovate-cuneate, truncate-emarginate, flat or loosely folded leaflets 4–20 mm. long; *peduncles* erect or incurved, (1.5) 2.5–8.5 cm. long, shorter than or equaling the leaf; *racemes* shortly, at first rather densely (10) 12–24-flowered, the axis not or little elongating, 1–4 (6) cm. long in fruit; *calyx* 7–10.4 mm., the cylindric or deeply campanulate tube (5.1) 5.5–8 mm. long, (2.5) 2.7–3.5 (4) mm. in diameter, the teeth 1.5–3.2 mm. long; *petals* pink-purple, drying violet, ultimately fading brownish; *banner* (12.6) 14.5–19 mm. long, (5.8) 7–9.8 mm. wide; *wings* (11.8) 12.5–16.7 mm., the blades (7) 7.6–9.6 mm. long; *keel* (11) 11.5–14.7 mm., the blades (5.8) 6.2–7.7 mm. long; *pod* (1) 1.4–2.7 (3) cm. long, (6.5) 8–18 mm. in diameter, greatly or sometimes little inflated, the body plumply ovoid or subglobose, more rarely (transition to var. *palans*) narrowly lance-ovoid, abruptly contracted (or when narrow tapering) into a more or less incurved, triangular-acuminate, uni- or bilocular beak (3) 4–10 mm. long, sulcate along both sutures, the green, purple- or red-tinged or brightly mottled valves glabrous, becoming stiffly papery or leathery, the septum (2) 2.5–5 mm. wide; *ovules* 28–35.—Collections: 66 (x); representative: *Rusby* 570 (GH, NY, UC); *Peebles & Smith* 13,964 (NY, SAC); *MacDougal* 144 (F, GH, NY, PH, POM, UC); *Peebles* 11,996 (CAS, SAC); *McVaugh* 14,508 (CAS, NY); *A. & G. Heller* 3541 (ND, NY, OB, GH); *Barneby* 12,606 (CAS, RSA).

Sandy plains, mesas, rocky slopes in canyons, sometimes on dunes or along sandy roadsides, in yucca-grassland, piñon or juniper forest, and other xeric associations, without apparent rock preference, but perhaps most abundant on sandstone and volcanic substrata, 4850–7400 feet, widespread and locally abundant across northern Arizona south of the Colorado River, from the head of the Verde River to the upper Little Colorado, east across the Continental Divide to the Rio Grande Valley in northwestern and central New Mexico, extending rarely north into the southwest corner of Colorado (Mesa Verde) and to the Henry Mountains in Garfield County, Utah.—Map No. 131.—March to June, sometimes again in fall.

ASTRAGALUS LENTIGINOSUS var. *DIPHYsus* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 673. 1895, based on *A. diphysus* (double-bladdered, of the swollen, bilocular pod) Gray in Mem. Amer. Acad. II, 4 (Pl. Fendl.): 34. 1849.—“... around Sante Fe, in red sandy soil; No. 146.”—Holotypus, collected by August Fendler in 1847, GH! isotypi, BM, F, GH, K, MO (2 sheets), NY, P!—*Tragacantha diphysa* (Gray) O. Kze., Rev. Gen. 944. 1891. *Cystium diphysum* (Gray) Rydb. in Bull. Torr. Club 32: 659. 1905.

Astragalus diphysus var. *albiflorus* (white-flowered) Gray, l.c. 1849.—“With the preceding. No. 147.”—Lectotypus, *Fendler* 147, collected “on light sandy soil on the plains about Santa Fe, May 10, 1847,” MO! isotypus, GH (but received long after Gray’s death and not annotated by him)!

Astragalus MacDougalii (Daniel Trembly MacDougal, 1865–1958, from 1905 to 1928 director of botanical research for the Carnegie Institution) Sheld. in Minn. Bot. Stud. 1: 169. 1894 (“*macdougalii*”).—“... near the top of Walnut canon, near Flagstaff, Arizona, June, 1891, by D. T. MacDougal...” —Holotypus, MINN! isotypus, US!—Note that *Rusby* 570, cited by Barneby, 1945, p. 115, as type-collection of *A. MacDougalii*, is not so.—*A. lentiginosus* var. *MacDougalii* (Sheld.) Jones in Proc. Calif. Acad. Sci. II, 5: 673. 1895. *Cystium MacDougalii* (Sheld.) Rydb. in N. Amer. Fl. 24: 415. 1929.

The var. *diphysus* carries the theme already stated by var. *araneosus*, one of large, purple flowers followed by shortly racemose, glabrous pods, south and east across the plateaus of northern Arizona into the Four Corners country and the Rio Grande Valley in northcentral New Mexico. The poor differential characters of var. *araneosus*, allopatric northward, have been mentioned above; within its limits of dispersal var. *diphysus* is the only freckled milk-

vetch encountered on the open plains and on the foothills either below 7000 feet or below the limit of yellow pine, and is easily recognized in practice. In Coconino County, Arizona, one must be careful to distinguish var. *oropedii*, endemic to the North Rim of Grand Canyon, and on the Flagstaff Plateau var. *Wilsonii* with its narrow pod of linear-ellipsoid outline.

The pod of var. *diphysus* is variable in size and degree of inflation, although no more so than that of most other forms of *A. lentiginosus*. A phase of it, often of depauperate stature, found in greatest abundance on the thin volcanic soils around the San Francisco Peaks, has a small subglobose or plumply ovoid pod about 1–1.5 cm. long, but seems hardly to deserve taxonomic status (= *A. MacDougali* Sheld.). As var. *diphysus* approaches the canyons of the Colorado in northern Arizona, the pod tends to become less and less swollen, finally passing imperceptibly into var. *palans* (q.v.). Likewise as we pursue it southward along the Rio Grande, we find evidence of an equally gradual passage into var. *australis*, ideally distinguished by its longer and looser racemes of thinner-walled fruits.

According to Jones (1923, p. 155 and Index) *A. diphysus* var. *albiflorus* is referable to *A. Pattersoni*, not to var. *diphysus*. It is true that Fendler might easily have collected *A. praelongus* var. *Ellisiae* (= *A. Pattersoni* sensu Jones, p. p.) at Santa Fe, but the specimens of his No. 147 as represented at GH and MO are certainly var. *diphysus*, presumably an albino form although the flowers are now brownish and the color not decipherable. The error on Jones's part probably arose from a specimen of *A. praelongus* collected in the Moqui Country in northern Arizona by Newberry in 1858 (US), for this was misidentified by Gray as *A. diphysus* var. *albiflorus* and is the only sheet on which I have found this name written in his hand. Granted that var. *albiflorus* is a taxonomic synonym of var. *diphysus*, strict adherence to the Rules of Nomenclature require that the earlier in the varietal rank takes precedence. Where the law asks an absurdity and runs counter to common sense and the meaning of words, it loses the respect without which it cannot function legitimately. In the belief that the rule will be modified to deal with cases of this sort, I have avoided proposing the legally required transfer.

289u. ASTRAGALUS LENTIGINOSUS var. AUSTRALIS

Coarse perennial of short duration, strigulose-villosulous with largely straight and appressed or largely sinuous and ascending or spreading hairs up to 0.4–1.2 mm. long, the herbage green or greenish-cinereous, the leaflets glabrous above and sometimes so beneath; *stems* several or numerous, decumbent and ascending in low clumps, 2.5–4 dm. long, simple or branched at base, commonly robust and hollow below the middle, stramineous and striate in age; *leaves* (5) 6–17 cm. long, with (13) 15–21 (23) obovate, broadly elliptic, rhombic-ovate, or rarely suborbicular, emarginate or retuse, flat or loosely folded leaflets (4) 6–25 mm. long; *peduncles* usually stout, 3–7 (9) cm. long; *racemes* loosely (10) 15–33-flowered, the axis (3.5) 4–12 cm. long in fruit; *calyx* (5.3) 6.4–10.8 mm., the tube (4.5) 4.8–7 mm. long, 2.5–3.6 mm. in diameter, the teeth (0.8) 1.6–3.8 mm. long; *petals* pink-purple, sometimes pale, the color fugacious in drying; *banner* (13.2) 14.5–18 mm. long, 7.2–9.8 mm. wide; *wings* (12.1) 14.2–16.2 mm., the claws (5) 5.5–7 mm., the blades (8.1) 8.5–11 mm. long; *keel* 1 mm. shorter, as long, or rarely 0.5 mm. longer than the wings, (11.5) 13.2–16.2 mm., the claws (5) 5.7–7.5 mm., the blades 7–10 mm. long, 3–3.8 mm. wide; *pod* narrowly to broadly ovate-acuminate or broadly lance-acuminate in profile, slightly or greatly inflated, 1.2–2.2 cm. long, (4) 5–13 (15) mm. in diameter, usually strongly incurved, contracted distally into a deltoid or triangular-acuminate, distally unilobular beak about 4–8 mm. long, the thinly papery, green or faintly mottled, glabrous or rarely thinly pubescent valves turning stramineous or purplish, the complete septum about 1.7–5.5 mm., the funicular flange 0.5–1.1 mm. wide; *ovules* 18–22.—Collections: 31 (v); representative: *A. & R. Nelson 1534* (NY, UC); *Jones 26.183* (GH, POM); *Eastwood 8599* (CAS, GH); *Ripley & Barneby 11,203* (CAS, RSA).

Open desert, sandy playas and outwash fans, plains, and washes in the foothills of desert mountains, 2200–4250 feet, with *Larrea*, *Carnegiea gigantea*, or in yucca-grassland, locally plentiful in southeastern Arizona, south of the Gila River

and eastward from the Papago Indian Reservation, east through southwestern New Mexico to the Rio Grande in Doña Ana County, south just into Sonora and Chihuahua.—Map No. 131.—(January) February to May.

ASTRAGALUS LENTIGINOSUS var. *AUSTRALIS* (southern) Barneby in Leaf. West. Bot. 4: 117, Pl. III, figs. 15–19. 1945.—“Type. Near Robles, east side of the Baboquivari Mts., Pima County, Arizona, Aven & Ruth Nelson No. 1537 . . .”—Holotypus, NY! isotypi, RM, UC!

The var. *australis* achieves characteristic facies and climactic development only in the sahuaro deserts of southeastern Arizona, mostly below 3000 feet elevation, and is easily recognized there by its loosely racemose flowers of good size which are succeeded by pods of papery texture. It is ordinarily a coarse plant with diffuse, basally fistular stems and resembles var. *yuccanus* quite closely in technical characters, although distinguished at anthesis by its purple flowers mostly of slightly larger size and with keel-blades even longer and more prominent. However as var. *yuccanus* comes south toward the Gila River in central Arizona, the ordinarily yellowish or whitish petals assume a flush of pink or lilac toward the tips, and these populations serve as a connecting link between the two varieties. The typus of var. *australis* was chosen deliberately as an example of the most extreme phase of its category, with pods small, little inflated, and somewhat clawlike, superficially like those of a form of var. *palans* to which Jones 1930, p. 27) referred his own collection. It was realized from the first, but is perhaps worth emphasizing once again, that a pod of this nature is not a constant attribute of var. *australis*, even in Arizona. Quite often here, and always eastward so far as I am aware, the pod is greatly swollen, in no respect different from that of var. *yuccanus* or, except for its thinner texture, from that of var. *diphysus*. In southern New Mexico and Chihuahua the plants here referred to var. *australis* are for the most part more slender and have shorter racemes in fruit, thereby taking on such a close resemblance to var. *diphysus* that no doubt can exist of a near affinity in that direction also. As happens so often in *A. lentiginosus*, var. *australis* intergrades into a vicariant variety wherever the ranges of dispersal provide the proper setting.

289v. *ASTRAGALUS LENTIGINOSUS* var. *YUCCANUS*

Robust winter-annual or short-lived perennial, commonly flowering the first year, strigulose or villosulous, or both, with straight and subappressed, straight and ascending, or largely sinuous, spreading and ascending hairs, the stems often canescent at and near the lowest nodes, sometimes also distally when young, the herbage green or greenish-cinereous, the leaflets bicolored, paler or yellowish-green and glabrous above; *stems* (in seedlings solitary) several or many, commonly stout and hollow, erect and ascending in clumps, 1.5–4 dm. long, simple or spurred (branched) at 1–5 nodes preceding the first peduncle; *leaves* (5) 7–16 cm. long, the upper ones mostly sessile, with 13–21 (25) broadly elliptic, oval, rhombic-obovate, or obovate, retuse or emarginate, flat or loosely folded leaflets (4) 6–21 mm. long; *peduncles* (3) 5–10 cm. long; *racemes* loosely (12) 15–32-flowered, the axis early elongating, (4.5) 6–14 cm. long in fruit; *calyx* 6–7.5 mm. long, strigulose or villosulous with white or partly black hairs, the deeply campanulate or subcylindric tube 4.4–5.7 mm. long, 2.6–3.1 mm. in diameter, the teeth (1.3) 1.5–2.4 mm. long; *petals* white or ochroleucous and concolorous, or the keel-tip, and sometimes the banner, faintly lilac-tinged; *banner* broadly rhombic-obovate-cuneate, 11–15.6 mm. long, 6.2–9 mm. wide; *wings* as long or up to 2 mm. shorter, 11–13.5 mm. long, the claws 4.8–6 mm., the blades 7.1–9.1 mm. long, 1.9–2.8 mm. wide; *keel* 0.1–1.2 mm. shorter than the wings, the claws 4.5–6.3 mm., the prominent blades 6.4–7.6 mm. long, 2.8–3.3 mm. wide; *pod* plumply ovoid-acuminate or subglobose, strongly inflated, 1.5–2.2 (2.5) cm. long, 1–1.8 cm. in diameter, the deltoid or triangular-acuminate, more or less incurved beak unilocular and 3–7 mm. long, the pale green, glabrous or rarely strigulose valves becoming papery-membranous, stramineous, lustrous, subdiaphanous, the complete septum 4–7 mm. wide; *ovules* 17–26.—Collections: 16 (iii); representative: *Palmer* 589 (F, NY); *Harrison & Kearney* 7613 (F, NY, SAC); *Eastwood* 18,000, 18,370 (CAS); *Ripley & Barneby* 4261 (CAS, RSA).

Open sandy plains, sandy or rocky washes, and gulches in the foothills of desert mountains, with *Larrea* and in yucca-grassland, 1700–3300 feet, common and locally plentiful in parts of Mohave, western Yavapai, and Maricopa Counties, Arizona, south (perhaps disjunctly) to southern Pima County.—Map No. 131.—February to May.

ASTRAGALUS LENTIGINOSUS var. **YUCCANUS** (of *Yucca*, Arizona) Jones, Contrib. West. Bot. 8: 3. 1898 ("*Yuccanus*").—"Collected by the writer at *Yucca* Ariz., 1884."—Holotypus (Jones 3886), collected May 13, 1884, POM!—Isotypi, F, GH, NY, OB, US, UTC!—*Cystium yuccanum* (Jones) Rydb. in N. Amer. Fl. 24: 407. 1929. *A. yuccanus* (Jones) Tidest. in Proc. Biol. Soc. Wash. 48: 40. 1935. *A. Fremontii* var. *yuccanus* (Jones) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 216. 1941.

It is pointed out above that in the material referred to var. *australis* a gradual transition can be traced from the group of varieties typified by var. *diphysus*, and characterized by a perennial root, diffuse stems, and compact racemes of rather stiff-walled pods, into a larger assemblage of desert-dwelling forms. These plants are of more rapid growth and shorter duration, with stems ordinarily erect and ascending in clumps, and open racemes of usually papery or papery-membranous fruits. Of this second group var. *yuccanus* is the first to merit description, since it is geographically and morphologically nearest to var. *australis*, and apparently passes into it by a continuous series of variants. The variety is typically developed on the vast terraces by means of which the topography of western Arizona slopes off from the limestone-capped Peach Springs plateau toward the lower Colorado River. In this area it is extremely common, sometimes the most abundant herbaceous species over hundreds of acres, and assumes a strong individuality by virtue of its poorly graduated, white or often distinctly yellowish petals with relatively large and prominent keel as often as not faintly lilac-tinged at tip.

289w. **ASTRAGALUS LENTIGINOSUS** var. **STRAMINEUS**

Short-lived perennial, sometimes flowering the first season, strigulose with appressed and ascending hairs up to 0.4–0.6 mm. long, the stems silvery-canescens, the herbage silvery or more often greenish, the leaflets glabrous or medially glabrescent above; stems 1.2–3.5 (4) dm. long; leaves (2.5) 4–11 (13) cm. long, with (9) 11–15 broadly oblanceolate or obovate-cuneate, openly notched, flat leaflets (3) 5–18 mm. long; peduncles 3.5–9 cm. long; racemes loosely or remotely 15–25 (30)-flowered, the flowers ascending, the axis 5–12 cm. long in fruit; calyx 5–6.6 mm. long, white-strigulose, the tube 3.8–4.5 mm. long, 2.1–2.5 mm. in diameter, the teeth 1.2–2.1 mm. long; petals pale purple or lilac, early fading brownish or ochroleucous after drying; banner 11–12 mm. long, 5–6.2 mm. wide; wings 10–11.2 mm. long, the blades 6.5–7.2 mm. long; keel 10–10.4 mm., the blades about 6 mm. long; pod obliquely ovoid-acuminate, (1) 1.7–2.6 cm. long, 1–1.6 cm. in diameter, bladdery-inflated, the incurved, triangular or lance-acuminate, distally unilocular beak (2) 3–7 mm. long, the rather firmly papery, greenish but usually mottled, strigulose valves becoming stramineous, the septum complete, 3–4.5 mm. wide, the funicular flange 0.7–1 mm. wide; ovules 20–26.—Collections: 9 (i); representative: *Palmer 116* in 1877 (GH, NY); *Peebles & Parker 14,767* (GH, NY, SAC); *Eastwood & Howell 9037* (CAS); *Maguire & Blood 4415* (F, POM, UC); *Ripley & Barneby 4295* (RSA).

Sandy and gravelly valley flats and dunes, $\pm$ 2000–3000 feet, locally plentiful in the lower Virgin Valley, in Mohave County, Arizona, and adjoining Clark County, Nevada; reported, perhaps incorrectly, from "south-eastern Utah," but without precise locality.—Map No. 131.—April and May.

ASTRAGALUS LENTIGINOSUS var. **STRAMINEUS** (Rydb.) Barneby in Leaf. West. Bot. 4: 122. 1945, based on *Cystium stramineum* (straw-colored) Rydb. in N. Amer. Fl. 24: 409. 1929.—"Type collected in southeastern Utah in 1870, E. Palmer..."—Holotypus, NY! isotypus, US!

The var. *stramineus* is nearly related to var. *yuccanus* and var. *variabilis*. It is obviously, even if only superficially distinguished from the first by its lilac-purple flowers, but should

perhaps be united with the polymorphic var. *variabilis*. The latter differs ideally but not quite consistently in having calyx-teeth shorter in relation to the tube. It enjoys a range of dispersal in the central and western Mohave Desert separated from that of var. *stramineus* by an extensive tract of territory in which the only freckled milk-vetch is the much smaller-flowered var. *Fremontii*. The var. *stramineus* has an intangible individuality of aspect and probably arose independently of var. *variabilis*.

The description of var. *stramineus* has been prepared principally from examples of the populations found on the sandy floor of the lower Virgin River Valley around Beaver Dam, Littlefield, and Mesquite. As mentioned elsewhere (Barneby, 1945, p. 122) the typus of *Cystium stramineum* is a fragmentary specimen simply labeled "Southeast Utah" and differs in having longer and straighter pubescence and notably bicolored leaflets. The color of the long-faded petals is not known for certain, but I have assumed them to have been purple as in the plant collected by Capt. Bishop in 1874 (POM), the one specimen seen that really closely matches the original *C. stramineum*. Bishop's plant is labeled "southern Utah" and may well have come from the Kanab region, or from adjoining northern Arizona, although the very glabrous var. *vitreus* is the freckled milk-vetch dominant around the foot of the escarpment eastward from Zion Park. A modern collection from a precise locality of truly typical *C. stramineum* will be awaited with interest, for final disposition of the epithet is contingent upon this rediscovery.

289x. ASTRAGALUS LENTIGINOSUS var. VITREUS

Perennial, with numerous decumbent and ascending stems, the herbage dark green, the leaflets very thinly strigulose beneath with subappressed hairs up to 0.35–0.5 mm. long, glabrous above, commonly ciliate; *leaves* 4.5–10 cm. long, with (7) 13–19 obovate-cuneate or oblong-obovate, obtuse or commonly truncate-emarginate, rather thick-textured, flat leaflets (5) 7–17 (21) mm. long; *peduncles* erect, 4–9.5 cm. long; *racemes* loosely (10) 15–27-flowered, the axis 4–8.5 cm. long (rarely shorter in depauperate, subterminal racemes); *calyx* 6.5–8 mm. long, the deeply campanulate or cylindric tube 4.6–5.7 mm. long, 2.1–3.4 mm. in diameter, the teeth (1.5) 1.7–2.3 mm. long; *petals* pink-purple or lavender with white wing-tips, at first drying bluish, the color fugacious in the herbarium; *banner* 13.2–17 mm. long, 6.4–9.6 mm. wide; *wings* 11–14.3 mm., the claws 4.3–5.4 (6.6) mm., the blades 7.5–10 mm. long, 1.8–2.8 mm. wide; *keel* 10–12 (12.5) mm., the claws 4.6–5.4 (6.4) mm., the blades 5.9–6.8 mm. long; *pod* 1.5–2.5 cm. long, (0.7) 0.9–1.5 cm. in diameter, usually strongly inflated, with broadly ovoid body abruptly contracted into a short, triangular, slightly incurved beak, but rarely less inflated, lunately lance-acuminate in profile, gently incurved from near the base, the papery-membranous, glabrous, unmottled valves pale green turning pallid and lustrous in age; *ovules* 21–31.—Collections: 16 (ii); representative: *Eastwood & Howell 9155* (CAS, RSA); *C. L. Hitchcock 3025* (F, POM, WS, WTU); *Jones 25,443* (POM); *Ripley & Barneby 8514* (CAS, RSA); *McClintock 52-179* (CAS, NY), 52-275 (CAS, RSA).

Gullied badlands and desert flats, in sand or clay derived from sandstone, occasionally in volcanic gravel, 2750–4700 (6300) feet, locally plentiful and rather common in the valleys of the upper Virgin River and Kanab Creek, south to the north slope of the Kaibab Plateau, Toroweap Valley, and House Rock Valley, in Washington (? and southern Kane) County, Utah, and northern Mohave and northwestern Coconino Counties, Arizona; possibly in adjoining Nevada (cf. *infra*).—Map No. 131.—April to June.

ASTRAGALUS LENTIGINOSUS var. VITREUS (shining like glass, of the ripe pod) Barneby in *Leaflet West. Bot.* 4: 119, Pl. III, figs. 30–33. 1945.—"... 5 miles west of Leeds, Washington County, Utah, *Bassett Maguire & H. L. Blood* No. 4413 ..."—Holotypus, collected May 19, 1933, POM! isotypus, UTC!

The var. *vitreus* might be visualized as a large-flowered version of some glabrescent state of var. *Fremontii*, or alternatively as a phase of var. *diphyssus* in which the racemes have become drawn out and loose and the pod papery-membranous and transparent rather than stiffly papery or leathery and opaque. In the trough lying between the Zion Escarpment and the

Kaibab Plateau, var. *vitreus* is the only freckled milk-vetch with green leaves and stems and with glabrous ovary and pod. Forms intermediate between var. *vitreus* and var. *stramineus*, which occur so close together (although not truly sympatric) in the Virgin Valley, are to be expected but have not yet turned up. A specimen from Star Springs on the south slope of the Henry Mountains (Harrison 11,521, US) has been identified by me as var. *vitreus*, probably mistakenly, for material collected subsequently in the same area (McVaugh 14,509, CAS, NY) seems better referred to var. *diphysus*. An indifferent specimen from Mica Spring in eastern Clark County, Nevada (Jones 5272d, POM) is suggestive both of var. *vitreus* and of var. *ambiguus*; but as it cannot be identified with any assurance, it has been omitted from the maps.

289y. ASTRAGALUS LENTIGINOSUS var. AMBIGUUS

Coarse perennial, the stout, erect stems stramineous, the herbage thinly strigulose or nearly glabrous, the leaflets bicolored, yellow-green and glabrous above; stems 3–5 dm. long, spurred below, floriferous from near or below the middle; leaves 7–14 cm. long, with 13–21 oblong-obovate or oblanceolate, retuse-emarginate, flat leaflets (3) 7.5–15 mm. long; peduncles erect, 7–11 cm. long; racemes loosely (7) 15–20-flowered, the axis (4) 5.5–9 cm. long in fruit; calyx 6.7–8 mm. long, thinly white or black-strigulose, the tube 5–5.7 mm., the teeth 1.6–2.3 mm. long; petals purple, drying violet, the auricles of the wings often fleshy-thickened; banner (13) 15–16.7 mm. long; wings 11–14 mm. long, the claws 5.1–6 mm., the blades 6.5–8.8 mm. long; keel 11.3–12.2 mm. long, the claws 5.6–5.8 mm., the blades 6.1–7.3 mm. long; pod 1.5–2.2 cm. long, inflated but firm, $\pm$ 9–13 mm. in diameter, the body plumply ovoid or subglobose, the beak 2–5 mm. long, broadly deltoid to triangular-acuminate, the valves stiffly papery or almost leathery, glabrous or rarely puberulent, green becoming stramineous and lustrous, not mottled; ovules 22–34.—Collections: 4 (i); representative: Kearney & Peebles 11,094 (ARIZ, POM); Jones (from Peach Springs) in 1904 (POM); Jones (from Chloride) in 1903 (POM).

Open hillsides, 4000–4800 feet, on limestone or granite, local but forming colonies, known only from Mohave County, Arizona, south of the Colorado River.—Map No. 131.—April and May.

ASTRAGALUS LENTIGINOSUS var. AMBIGUUS (of doubtful relationship) var. nov., var. *vitreo proxima*, imprimis legumine subcoriaceo nec chartaceo diversa.—ARIZONA: Peach Springs, Mohave County, May 11, 1941, Ripley & Barneby 3403.—Holotypus, RSA!—*A. lentiginosus* var. *mokiensis* fma. β Barneby in Leaflet West. Bot. 4: 138, Pl. IV, fig. 39. 1945.

The freckled milk-vetch described here as var. *ambiguus* has been known for many years, but no satisfactory disposition of the material has ever been made. Jones labeled his collection from Chloride as “var. *yuccanus* varying toward var. *mokiensis*,” and I was probably influenced by this annotation when I interpreted the plant as a form of var. *mokiensis* with inflated fruit. The genuine *A. mokiensis*, although quite like var. *ambiguus* in habit and in details of the flower, is an emmenoloboid species transferred in these pages to sect. *Preussiani*; consequently the Peach Springs astragalus (or fma. β), a genuine member of the *A. lentiginosus* complex, has been left without name or niche in the genus. It is apparently most nearly related to var. *vitreus* and var. *diphysus*, resembling the former in habit but differing in the leathery pod and separable from the latter by the open racemes which reach a length of 5–9 cm. in fruit. Even in the small amount of material available, which may represent samples from only two populations, there is some perceptible but hardly significant variation in pubescence and flower-size. At Peach Springs the ovary and pod are glabrous, but in the plant from Chloride thinly strigulose.

289z. ASTRAGALUS LENTIGINOSUS var. FREMONTII

Annual, biennial, or perennial of short duration, with a solitary and erect or more often several diffuse and ascending stems, densely to quite thinly strigulose or more rarely villosulous with straight and appressed or narrowly ascending, with all incumbent, or with all or mostly sinuous or curly hairs up to 0.3–0.75 mm.

long, the herbage mostly cinereous or canescent, sometimes green, more rarely silvery-silky, the leaflets nearly always pubescent on both sides, occasionally glabrous above, or more densely pubescent above than beneath; *stems* stout or slender, (0.4) 0.8–3.5 (4) dm. long; *leaves* (3) 4–9 (12) cm. long, with (9) 11–19 ovate- or obovate-cuneate, broadly oblanceolate, or rhombic-elliptic, obtuse, emarginate, or rarely subacute, flat or loosely folded leaflets 5–19 mm. long; *peduncles* erect or incurved, 2.5–8.5 (10) cm. long, a little longer or shorter than the leaf; *racemes* loosely (8) 10–30-flowered, the axis (2.5) 4–11 (16) cm. long in fruit; *calyx* (3.4) 3.8–6 (7.9) mm. long, strigulose or villosulous with black, white, or mixed hairs, the tube (2.8) 3–4.5 mm. long, 1.9–2.6 mm. in diameter, the teeth (0.6) 0.9–2 (3.5) mm. long; *petals* bright purple, occasionally varying through shades of pink-lilac to pure white in the same colony; *banner* 9.1–12 (12.4) mm. long, (4.2) 5–7 (7.8) mm. wide; *wings* (7.4) 8–10.6 mm., the claws (2.7) 3–4.4 mm., the blades 5.2–7.3 mm. long; *keel* (5.6) 6.2–8.6 mm. long, the claws (2.8) 3.1–4.6 mm., the blades (3.1) 3.4–4.8 mm. long, (1.8) 2–2.5 mm. wide; *pod* nearly always bladdery-inflated, broadly and plumply or rarely quite narrowly ovoid-acuminate, 1.4–2.7 (3.6) cm. long, (5) 8–18 mm. in diameter, contracted or more rarely tapering into a more or less incurved, unilocular beak (2) 3–7 (10) mm. long, the pale green, often purple-freckled or -mottled, glabrous or thinly strigulose-villosulous valves becoming papery-membranous, lustrous, subdiaphanous, the septum complete or nearly so; *ovules* (17) 19–31.—Collections: 101 (xiv); representative: *Duran* 3025 (CAS, GH, OB, POM, UC, WIS); *Ferris & Bacigalupi* 8063 (OB, POM, UC); *Jones* (from Argus Mts.) in 1897 (GH, NY, POM); *C. B. Wolf* 9663 (UC, WS), 16,522 (CAS); *Pl. Exiscc.* Gray. 723 (= *Clokey* 7176); *Maguire & Holmgren* 25,138, 25,143 (NY, RSA, WS), 25,177 (NY, RSA); *Train* 2689 (NA, NY, albino form); *Eastwood & Howell* 9453 (CAS, RSA, WS).

Sandy flats, washes, desert playas, gravelly hillsides, and open valleys, with creosote-bush, Joshua-tree, greasewood, sagebrush, rabbit-brush, and in piñon-juniper forest, most common and abundant in loose sandy soils but with no apparent rock preference, mostly from 3000 to 6500 feet, but ascending in the White and Inyo Mountains to 8200 feet and on the east face of the Sierra Nevada rarely up to the 9000–9500 feet contours (there entering the Jeffrey pine belt), widespread and locally dominant over extensive areas of sandy desert, nearly throughout the south third of Nevada (northeastern Nye County to the Muddy River Valley, west to the White Mountains and south to the Colorado River), west to the head of Owens Valley in Inyo and extreme southern Mono Counties, California, and south to the Argus Mountains and Coso Junction (northeastern Kern County) and through Death Valley to the Clark, New York, Providence, and Old Dad Mountains in the eastern Mohave Desert.—Map No. 130.—Late March to July, sometimes again in September or October.

ASTRAGALUS LENTIGINOSUS var. *FREMONTII* (Gray) Wats., Bot. King 66. 1871, based on *A. Fremontii*. (John Charles Fremont, 1813–1890, the Pathfinder, explorer of the West, U. S. general, and presidential aspirant) Gray ex Torr. in Pac. R. R. Rep. 4: 80. 1857.—“Banks of the Rio Virgin, May 3, 1844, Frémont.”—Holotypus, NY (herb. Torr.)! isotypus, GH!—*A. Coulteri* var. *Fremontii* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 669. 1895 (“*Fremontii*”). *Cystium Fremontii* (Gray) Rydb. in N. Amer. Fl. 24: 407. 1929.

Astragalus eremicus (desolate, from the desert habitat) Sheld. ap. Cov. in Contrib. U. S. Nat. Herb. 4 (Death Valley Rep.): 86. 1893.—“... No. 888, Death Valley Expedition; collected June 7, 1891, near Lone Pine [“on the mesa back of the cemetery” acc. Cov., op. cit., p. 253], Inyo County, California, by Frederick V. Coville.”—Holotypus, US!—*Cystium eremicum* (Sheld.) Rydb. in N. Amer. Fl. 24: 409. 1929. *A. Fremontii* subsp. *eremicus* (Sheld.) Abrams, Ill. Fl. Pac. St. 2: 597, fig. 2871. 1944.

Cystium griseolum (grayish) Rydb. in N. Amer. Fl. 24: 411. 1929.—“Type collected at

Candelaria, Nevada, May, 1882, *Shockley 220*; also 271 (both Gray Herbarium)."—Holotypus, No. 220, GH! isotypus, ND! paratypus, No. 271, GH!

Fremont's freckled milk-vetch may be distinguished ideally, and is in practice nearly always so, by its small flowers of a lively purple arranged in loose, finally elongating racemes. It is one of the commonest and most abundant astragali over a great part of southern Nevada and the northern and eastern Mohave Desert in California, sometimes found in vast numbers over the floor of desert valleys, whence it extends upward into the foothill canyons. In Lincoln County, Nevada, an albino mutant occurs rather commonly among the normal purples, sometimes associated with intermediate color-forms grading from palest shell-pink into deep claret- or violet-purples. Within its area of dispersal var. *Fremontii* is the only form of the species known to occur at low elevations, but at the periphery it passes northward into var. *Kennedyi* and southward, at the base of the Sierra Nevada, into var. *variabilis*. Variation in amount and orientation of the pubescence has been described above. The vesture tends to become increasingly dense as var. *Fremontii* is traced westward into California, the tendency culminating in the silvery-canescence phase described as *A. eremicus*, especially common in alkaline sandy soil around Owens Lake. Normally appressed or subappressed, the hairs on the leaves and stems, but especially on the latter, are often both loose and copious in the foothills of the White and Inyo Mountains; and in the same region the stems, particularly between 6000 and 8000 feet, tend to become short and diffuse, while the racemes at the same time fail to elongate in fruit. Plants exhibiting all of these peculiarities at once are quite uncommon, and I feel confident that *Cystium griseolum*, based on two collections of this sort from western Esmeralda County, Nevada, is best treated as a minor variant. Of theoretical interest because of its resemblance in all details but the purple flower to var. *macrolobus*, it serves as an additional link between the group of varieties exemplified by the soundly perennial, prostrate vars. *lentiginosus*, *salinus*, *macrolobus*, and *ineptus* with small, shortly racemose, whitish flowers, and the shorter-lived, often monocarpic or annual group of the southern deserts with their more or less erect stems and racemes of loosely disposed, mostly larger, and purple flowers.

289za. ASTRAGALUS LENTIGINOSUS var. KENNEDYI

Biennial or perennial but of short duration, rather coarse, villosulous nearly throughout with fine, curly and incumbent and also often some longer, straightish, ascending hairs up to 0.5–0.75 (1) mm. long, the stems commonly canescent or when young tomentulose, the herbage green or canescent, the leaflets nearly always pubescent on both sides, rarely glabrescent or subglabrous above; *stems* decumbent and ascending, (1) 1.5–4 (5) dm. long; *leaves* 4.5–12 (15) cm. long, with (9) 15–21 (23) obovate-cuneate to broadly oblong-oblancheolate, obtuse or (in some leaves) emarginate or retuse, flat or loosely folded leaflets (5) 7–20 mm. long; *peduncles* stout, erect, (3) 4.5–7.5 cm. long; *racemes* loosely (10) 15–35-flowered, the axis (3.5) 5–12 cm. long in fruit; *calyx* 6.1–8.8 mm. long, black or largely white-villosulous, the tube 4.1–5.7 mm. long, 2.4–3.3 mm. in diameter, the teeth 1.6–3.1 mm. long, usually arched outward; *petals* bright purple; *banner* (11.8) 12.5–17 mm. long, 6–9.2 mm. wide; *wings* (10.6) 11.6–14.6 mm., the claws 4.2–6.3 mm., the blades 6.9–9.3 mm. long, 1.4–3 (3.7) mm. wide; *keel* (8.4) 9.4–13.4 mm., the claws (4.1) 4.5–6 (6.4) mm., the blades (4.7) 5.5–7.6 mm. long, 2.3–3.4 mm. wide; *pod* narrowly, more rarely plumply ovoid-acuminate, (2) 2.5–3 cm. long, the bladderly-inflated body 0.9–1.5 cm. in diameter, tapering or abruptly contracted into a more or less incurved, unilocular beak 5–9 mm. long, the pale green, glabrous or exceptionally puberulent valves becoming papery-membranous, lustrously stramineous; *ovules* (24) 26–36.—Collections: 31 (iii); representative: *Maguire & Holmgren 25,505* (NY, RSA, WS), 25,512, 25,457 (NY, RSA); *A. Heller 10,915* (F, GH, NY, UC); *Archer 6195* (NA, NY); *Eastwood & Howell 81* (CAS).

Alkaline dunes, sandy valleys, and dry stony knolls, sometimes in volcanic gravel or cinders, 3700–5600 feet, locally plentiful about the low, arid basins of westcentral Nevada, from Pyramid Lake south to the latitude of Tonopah, Washoe to northern Nye and Esmeralda Counties.—Map No. 130.—April to June, sometimes again in September and October.

ASTRAGALUS LENTIGINOSUS var. *KENNEDYI* (Rydb.) Barneby in Leaf. West. Bot. 4: 121, Pl. III, figs. 20-25. 1945, based on *Cystium Kennedyi* (Patrick Beveridge Kennedy, 1874-1930) Rydb. in N. Amer. Fl. 24: 407. 1929.—"Type collected in the Carson Sink Region, October, 1907, *Kennedy 1691* . . ."—Holotypus, NY! isotypi, UC, US!

Kennedy's freckled milk-vetch is usually distinctive and well marked by its villosulous vesture, relatively large, loosely racemose, purple flowers, spreading calyx-teeth, and glabrous pod commonly but not consistently of rather narrowly ovate-acuminate outline. Toward its south limit in Esmeralda County the flowers become smaller and the pod puberulent, and the individual facies of var. *Kennedyi* fades imperceptibly into that of var. *Fremontii*. In my revision (1945, l.c.) var. *Kennedyi* was reported from Nye County on the basis of two collections. The first of these (*Eastwood & Howell 9482*) is a small-flowered variant of var. *Kennedyi* but came from west of Tonopah, in Esmeralda County. The second (*Ripley & Barneby 4427*), although resembling var. *Kennedyi* in habit of growth, is distinguished by its scanty, nearly straight pubescence, and is perhaps better interpreted as a glabrous-fruitlet, rather lax-racemed form of var. *araneosus*, at this point at the southwest limit of its range where intergradation with var. *Kennedyi* might be expected. Typical material of Kennedy's freckled milk-vetch has since been collected in northwestern Nye County.

289zb. *ASTRAGALUS LENTIGINOSUS* var. *VARIABILIS*

Perennial of short duration or monocarpic, usually coarse, but in dry sites or seasons capable of fruiting from a single stem less than 1 dm. long, the vesture highly variable in orientation and density, most commonly villosulous, sometimes densely villous-tomentulose, sometimes only thinly strigulose, the hairs spreading, ascending, or subappressed, and either straight (or largely so) or sinuous to curly, the longest up to 0.5-0.95 mm. long, the stems nearly always cinereous or canescent, the herbage most often cinereous, sometimes green or silky-canescenscent, the leaflets pubescent on both sides, sometimes more densely so above than beneath, or nearly to quite glabrous above; *stems* (0.4) 1-4 dm. long, solitary and erect in seedlings, more often several, diffuse and ascending; *leaves* (2.5) 4-13 cm. long, with 11-21 (25, or in some young plants only 7-13) obovate-cuneate to broadly oblanceolate or rhombic-elliptic, mostly obtuse or emarginate, more rarely acute or subacute, flat or loosely folded leaflets 4-15 (17) mm. long; *peduncles* erect or incurved, 3-8 (9) cm. long, shorter than or rarely equaling the leaf; *racemes* loosely (10) 12-25 (30)-flowered, the axis (3) 4-15 (17) cm. long in fruit; *calyx* 4.7-6.5 mm. long, thinly and loosely strigulose to densely villosulous with white and often some black or fuscous hairs, the tube 3.7-5.2 mm. long, 2.3-3 mm. in diameter, the teeth 1-1.4 (1.5) mm. long, the ventral pair usually shortest; *petals* pink- or magenta-purple, exceptionally white; *banner* 11.1-15 mm. long, 5.5-8 (8.6) mm. wide; *wings* 9.8-12.8 mm. long, the claws 4.1-5.7 mm., the blades 5.5-8 mm. long, 1.9-3 mm. wide; *keel* (mostly 0.2-2 mm. shorter, rarely up to 0.2 mm. longer than the wings) 8.4-12.3 mm. long, the claws 4.3-5.9 mm., the blades 4.7-6.7 mm. long, (2.3) 2.6-3.4 mm. wide; *pod* (1.2) 1.5-2.7 (3) cm. long, the obliquely ovoid or subglobose, bladdery-inflated body 8-14 (15) mm. in diameter, the gently incurved, triangular-acuminate, unilocular beak (3) 4-9 mm. long, the pale green or mottled, finally stramineous and rather firmly papery valves varying from thinly strigulose to densely and canescently strigose-villosulous, the complete septum 3-7 mm., the funicular flange 0.4-1 mm. wide; *ovules* 23-29.—Collections: 114 (ix); representative: *Munz 15,640* (CAS, POM, WS); *C. L. Hitchcock 12,235* (OB, POM, UC); *Clokey & Anderson 6686* (F, NY, POM, WS); *Constance & Mason 2212* (UC, WS); *Eastwood 3218* (CAS, GH, NY); *Twisselmann 3300, 3387, 3566* (NY); *Munz 9015* (POM, UC); *Keck & al. 6249* (NY).

Sandy flats, washes, desert playas, sometimes on dunes, commonly with *Larrea* between 800 and 3000 feet but extending in Kern County west into the southern Sierra foothills up to 5200 feet, common and locally abundant over the

southern and southwestern Mohave Desert, California, characteristically developed in eastern Kern, northeastern Los Angeles, and adjoining San Bernardino Counties, passing northward into var. *Fremontii* in southern Inyo County, and in the central Mohave Desert at low elevations into var. *coacheliae*; also at $\pm$ 450–650 feet on the floor of the upper San Joaquin Valley in Kern County, there found mostly along roadsides and in disturbed places, sometimes in natural arid grassland, possibly introduced from the desert, but closely resembling the native var. *nigricalycis* except for the purple flowers.—Map No. 132.—March to June.

ASTRAGALUS LENTIGINOSUS var. *VARIABLES* (variable) Barneby in Leaflet. West. Bot. 4: 123, Pl. IV, figs. 1–8. 1946.—“... Victor (now Victorville), San Bernardino Co., California, M. E. Jones in 1903 ...”—Holotypus (2 sheets), POM! isotypus, UC!

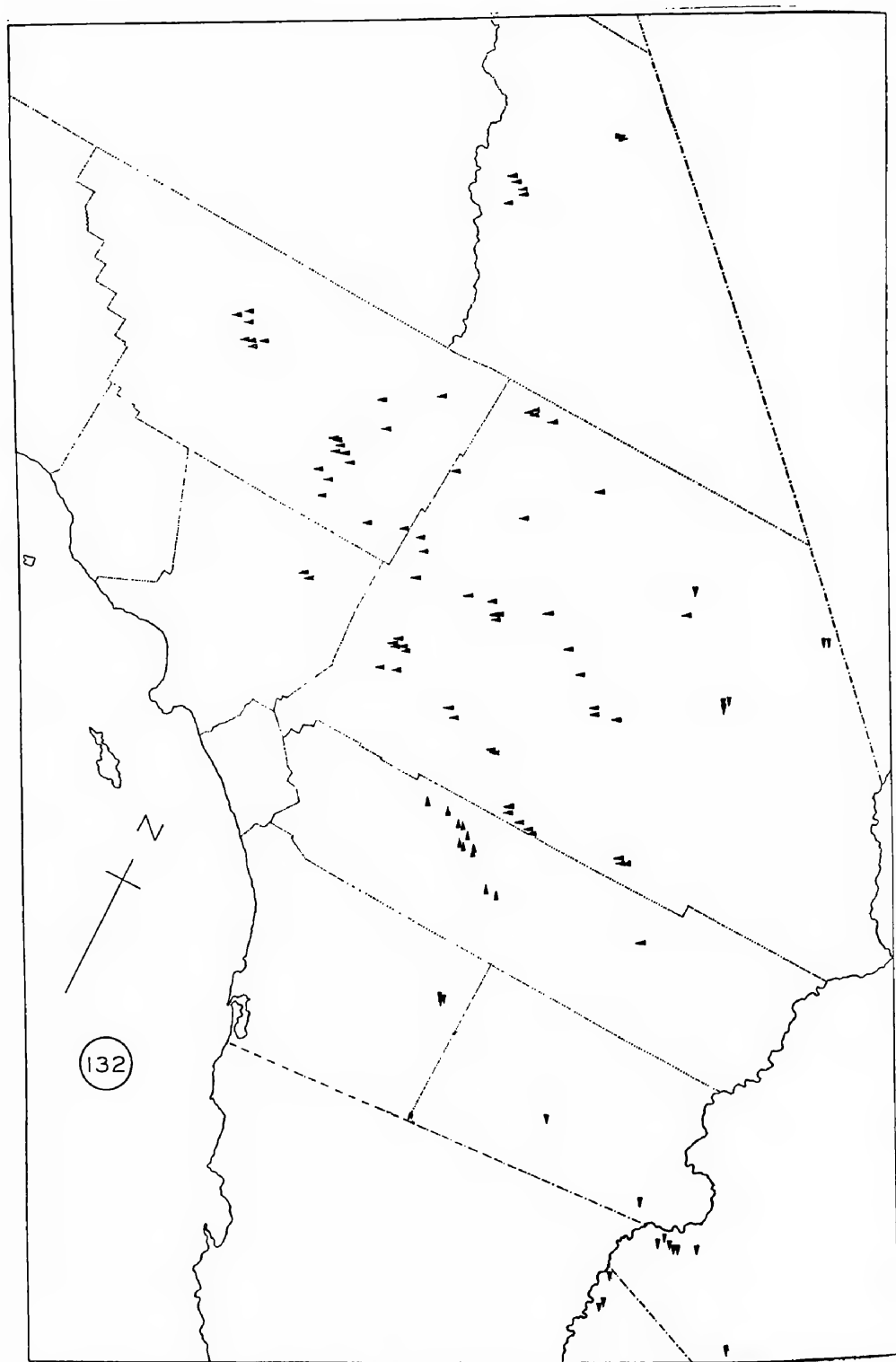
Cystium pardalotum (leopard-spotted, of the pod) Rydb. in N. Amer. Fl. 24: 415. 1929.—“Type collected in the Mohave Desert, California, in May, 1893, Dr. A. Davidson (herb. Univ. Minn.).”—Holotypus, MINN! isotypus (fragm.), NY!

The limits of var. *variabilis* are drawn to include all the heterogeneous populations of *A. lentiginosus* (other than the very distinct halophytic var. *albifolius*) known to occur over the floor of that part of the Mohave Desert lying between the transverse ranges to the southward, the Inyo County line at the north, and the Sierra foothills and the sink of the Mohave River to the west and east. The populations differ greatly one from another in density, distribution, and even type of indumentum clothing the stems and leaves, and together form a body of material, important by reason of individual numbers, which is geographically and morphologically intermediate between var. *Fremontii*, var. *coacheliae*, and var. *nigricalycis*. As might be expected in the context of the species, var. *variabilis* intergrades with each of these vicariant forms. Ideally and abundantly developed on the plains north of the San Bernardino Mountains, the variety is there easily distinguished from var. *Fremontii* by its larger flower (or at least longer keel), from var. *nigricalycis* by its purple petals and finer, more appressed and straighter pubescence, and from var. *coacheliae* by its greener leaves, more thinly pubescent pod, and shorter calyx-teeth. A quantity of material has already been cited (Barneby, 1945, p. 124) under the title of formae (equivalent to the minor variants of this account) to document the passage of var. *variabilis* into its three neighbors. The first of these, intergradient to var. *coacheliae*, has silvery herbage and canescent pod and is found locally, usually on dunes, in the central Mohave Desert (Ludlow, Baker, etc.). The second, with similarly canescent foliage but pod only thinly and sometimes loosely strigulose, is common along the foot of the Sierra between Owens Lake and Walker Pass, and by gradual shortening of the flower passes directly into the silvery phase of var. *Fremontii* known as *A. eremicus* Sheld. The third variant consists of plants in which the purple flowers proper to var. *variabilis* are combined with the diffuse stems and loose, coarse vesture of the cismontane, yellow-flowered var. *nigricalycis*. The last is certainly native at the edge of the desert in Kern County and is perhaps a recent immigrant on the Bakersfield Plain. The so-called “carinate” phase of var. *variabilis*, in which the keel becomes large and prominent, equaling or slightly exserted from between the wings, is locally plentiful about Victorville, Barstow, and Hesperia, in some places occurring in pure stands but in others mixed with the normally graduated type.

The history of the variety has been told elsewhere (Barneby, 1945, l.c.). It was first collected in 1844, by Fremont, on the Mohave River.

289zc. *ASTRAGALUS LENTIGINOSUS* var. *NIGRICALYCIS*

Perennial, commonly stout and coarse, the diffuse or assurgent stems (2) 2.5–5 dm. long, often fistular at base, cinereously or canescently villosulous (villos) with ascending or spreading (and often some shorter, curly or entangled), white and often partly black hairs up to 0.6–0.9 (1.2) mm. long, the herbage greenish-cinereous, the leaflets bicolored, villosulous beneath, glabrous or more thinly villosulous and yellowish-green above; leaves (4) 6–16 cm. long, with 19–25 oblong-oblongate to broadly obovate or rhombic-obovate, nearly always retuse, flat leaflets (3) 7–25 mm. long; peduncles mostly incurved-ascending, 4–11 cm. long; racemes at first rather closely, at length loosely (10) 15–32-flowered, the axis (2.5) 4.5–11 cm. long in fruit; calyx 6.4–8.2 mm. long, villosulous with black, fuscous, and often partly (rarely all) white hairs, the tube 4.7–6.2 mm. long, (2.7) 3–3.5 mm. in diameter, the teeth 1.4–2.5 mm. long; petals creamy-



Map No. 132. Southeastern California. Range (in part) of *A. lentiginosus*:  var. *coachellae*;  var. *variabilis*;  var. *micans*; and  var. *borreganus*.

or greenish-yellow, decidedly yellow when dry, immaculate; *banner* rhombic-ovate or -oblanceolate, 12–17 (18.5) mm. long, (6.5) 7.5–10.4 mm. wide; *wings* 11–15.6 mm., the claws 5.2–7 (7.7) mm., the blades (6.4) 7.4–9.1 mm. long, 2.1–3.2 mm. wide; *keel* 10.8–13 (14.1) mm. long, the claws 6–7.5 mm., the blades (5.4) 6.2–7.4 mm. long, 2.8–3.3 mm. wide; *pod* obliquely ovoid-acuminate, greatly inflated, (1.7) 2–3.5 cm. long, 1–2 (when pressed up to 1.3) cm. in diameter, contracted abruptly or tapering into a triangular-acuminate beak 4–8 mm. long, the mottled, villosulous valves becoming papery, the complete septum 2.5–5.5 mm. wide, usually produced into the base of the beak.—Collections: 56 (ii); representative: *A. Heller* 7587 (CAS, F, GH, NY, WIS); *Munz* 16,297 (CAS, NY, OKLA); *Eastwood & Howell* 2053 (CAS, GH, NY); *C. B. Wolf* 6333 (CAS, TEX, WS); *Twisselmann* 3271 (NY).

Rolling hills, plains, gravelly banks, and road cuttings, 300–2500 (3190) feet, common and locally abundant on the arid grasslands of the Inner South Coast Ranges from southwestern Fresno County, California, south to the Cuyama Valley in Santa Barbara County, and the foothills around the head of the Great Valley in Kern County.—Map No. 128.—March to May, rarely again in fall.

ASTRAGALUS LENTIGINOSUS var. *NIGRICALYCIS* (with black-hairy calyx) Jones in Proc. Calif. Acad. Sci. II, 5: 674. 1895.—“Bakersfield, Kern County, California, Miss Eastwood, March 24, 1893.”—Neotypus (Barneby, 1945, p. 127), collected by Eastwood at San Emigdio, Kern County, March 8, 1893, POM!—The holotypus, not found at CAS, probably lost in the fire of 1906, represented by a photograph at POM!—*Cystium nigricalyce* (Jones) Rydb. in N. Amer. Fl. 24: 408. 1929. *A. nigricalycis* (Jones) Abrams, Ill. Fl. Pac. St. 2: 598, fig. 2872. 1944.

Although very closely related to var. *variabilis* and scarcely distinguishable when in fruit from some villosulous phases of it, the present variety is readily recognized in practice by its yellowish petals and cismontane range of dispersal. The fresh flowers, as I have seen them, are of a peculiar greenish- or creamy-white which turns bright lemon-yellow when dried and creates a striking contrast with the usually copious black or fuscous vesture of the inflorescence. Where var. *nigricalycis* and var. *idriensis* are found near together in the Coast Ranges, the latter may be recognized after the purple flowers have faded by its subappressed vesture and shortly racemose pods of more stiffly papery or leathery texture. The variety is one of the least variable forms of *A. lentiginosus*. It seems to have been collected first in 1876, near Fort Tejon, by William Kennedy (F).

289zd. *ASTRAGALUS LENTIGINOSUS* var. *COACHELLAE*

Winter annual or short-lived perennial, densely strigulose-villosulous throughout with ascending or subappressed, nearly straight or wavy (and often some short, sinuous or curly) hairs up to 0.7–1 (1.2) mm. long, the herbage lustrously silvery-canescens, sometimes becoming greenish-cinereous in age; *stems* erect and ascending in clumps, (1) 1.5–3 dm. long; *leaves* 5–11.5 cm. long, with (7) 11–17 (21) broadly oval to obovate-cuneate, or oblong-elliptic, emarginate or obtuse and apiculate, flat or loosely folded leaflets 5–15 (17) mm. long; *peduncles* stout, erect, 3.5–8 cm. long; *racemes* loosely 11–25-flowered, the axis (3) 4–10 cm. long in fruit; *calyx* 6.6–7.8 mm. long, densely villosulous with white (and nearly always a few black or fuscous) hairs, the tube 4.5–5.3 mm. long, 2.7–3.2 mm. in diameter, the teeth 1.7–2.9 mm. long; *petals* pink-purple, the color quickly fading; *banner* 12.7–14.5 mm. long; *wings* (about 1 mm. shorter) 11.8–13.5 mm., the claws 4.7–5.9 mm., the blades 7.8–8.8 mm. long, 2.5–3 mm. wide; *keel* (0.7–1.8 mm. shorter than the wings) 10.8–11.6 mm. long, the claws 5–5.7 mm., the blades 6.3–6.8 mm. long, 3–3.4 mm. wide; *pod* broadly and obliquely ovoid-acuminate, greatly inflated, 1.6–2.1 cm. long, 0.9–1.4 cm. in diameter, broadly rounded at base, abruptly contracted into an erect or slightly incurved, unilocular beak $\pm$ 3.5–6 mm. long, the stiffly papery valves nearly always mottled, canescently strigu-

lose, the complete septum 3.5–6 mm. wide; *ovules* 24–30.—Collections: 34 (ii); representative: *Parry & Lemmon* 87 (F, GH, NY, UC); *H. M. Hall* 5757 (F, GH, NY, POM, UC); *G. B. Grant* 6747 (CAS, UC, WIS).

Sandy flats, washes, outwash fans, sometimes on dunes, locally plentiful in the *Larrea* belt from 20 feet below to 1200 feet above sea level around Coachella Valley, from the north end of Salton Sea to the base of Morongo and San Gorgonio Passes (and collected once near the head of the latter, near Banning, $\pm$ 2300 feet), interior Riverside County, California.—Map No. 132.—February to May.

ASTRAGALUS LENTIGINOSUS var. *COACHELLAE* Barneby ap. Shreve & Wiggins, Veg. Fl. Son. Des. 695. 1964.—“CALIFORNIA: Palm Springs, Riverside County, April 30, 1913, *Alice Eastwood* 3116.”—Holotypus, NY! isotypi, CAS, GH!

Astragalus lentiginosus var. *Coulteri* sensu Jones, Rev. Astrag. 127, pro max. parte, Pl. 25 (exclus. fig. a). 1923; Barneby in Leaf. West. Bot. 5: 129, Pl. IV, fig. 14–17. 1945. *Cystium Coulteri* sensu Rydb. in N. Amer. Fl. 24: 408. 1929. Non *A. Coulteri* Bth. (= *A. lentiginosus* var. *borreganus*).

The combination of silvery foliage with lively purple flowers, these followed by swollen, mottled but at the same time gray-downy pods, makes var. *coachellae* one of the handsomest forms of the freckled milk-vetch. It is probably a southern offshoot of the polymorphic var. *variabilis*, of which the uncommon phases with foliage equally silky may be distinguished by their short calyx-teeth and slightly smaller flowers. The variety is apparently confined to Coachella Valley, where it is sometimes associated on dunes with *A. Crotalariae*, a species with much longer flower and a pod inflated but unilocular.

The var. *coachellae* was apparently first identified with *A. Coulteri* Bth. by Jones, and in recent monographs and floristic works has been treated under that name (or equivalent combination). Gray (1864, p. 233) listed *A. Coulteri* as a doubtful species; he may have studied the holotypus after 1864, but apparently neither Jones nor Rydberg saw Coulter's plant, a very characteristic specimen of *A. lentiginosus* var. *borreganus*. Coulter is known to have reached the mouth of the Gila River, and I conjecture that it was in that region that he encountered the species, locally abundant in rainy seasons over the sandy plains of the Yuma Desert.

289ze. *ASTRAGALUS LENTIGINOSUS* var. *MICANS*

Strong perennial, the stems numerous, erect or the outer ones ascending in well-furnished clumps up to 5–7 dm. in diameter, becoming indurated or subligneous at base, the stems and herbage silvery- or white-silky, very densely villous-tomentulose with a coat of shorter, curly and longer, straighter, ascending, lustrous hairs up to 1.1–2 mm. long; *leaves* 4.5–9.5 cm. long, with 11–17 narrowly to broadly obovate or ovate, more rarely rhombic-suborbicular, truncate-emarginate to subacute leaflets 5–14 mm. long; *peduncles* stout, erect, 4.5–9 cm. long; *racemes* loosely (12) 20–35-flowered, the axis (3.5) 4.5–10 cm. long in fruit; *calyx* 6–7.6 mm. long, densely silky-villosulous with white and some fuscous hairs, the tube 4.6–4.9 mm. long, about 3 mm. in diameter, the teeth 1.4–2.6 mm. long; *petals* distally suffused with pink-lavender; *banner* ovate-cuneate, 12.2–14.3 mm. long, 8.4–10 mm. wide; *wings* 12.3–12.6 mm., the claws $\pm$ 4.7 mm., the blades 2.4–2.7 mm. wide; *keel* 9.6–10 mm., the claws 5 mm., the blades $\pm$ 5 mm. long and 3 mm. wide; *pod* obliquely ovoid, inflated, 1.5–2 cm. long, 0.8–1 cm. in diameter, contracted distally into an erect, unilocular beak 2.5–4 mm. long, the valves stiffly papery, not mottled, very densely silky-villous-tomentulose, the septum complete, 2.7–3.4 mm. wide; *ovules* 23–28.—Collections: 5 (o); representative: *Munz & Roos* 20,153 (RSA); *Douglas Powell* in 1932 (UC).

Forming large clumps scattered over the lower slopes of mobile dunes, $\pm$ 3050–3100 feet, south end of Eureka Valley, Inyo County, California.—Map No. 132.—April to June.

ASTRAGALUS LENTIGINOSUS var. *MICANS* (shining, of the silvery vesture) Barneby in Leaf. West. Bot. 8: 22. 1956.—“CALIFORNIA: . . . dunes at southeast end of Eureka Valley, east of

Inyo Mts., Inyo County . . . May 13, 1955 (fr.) *John C. Roos 6354*, and at the same place . . . April 9, 1955 (fl.) *Munz & Roos 20,851* . . ."—Cotypi, RSA! isotypi, NY, UC!

Like var. *coachellae*, which it most nearly resembles in its silken but even longer and denser vesture, var. *micans* is believed to represent an offshoot from var. *variabilis* which has acquired a certain individuality (or is at least enabled to maintain it) because of physical isolation in a desert basin walled about by formidable mountain barriers. The forms of *A. lentiginosus* geographically nearest to var. *micans* are var. *Fremontii*, quite common in the foothills of the Inyo and White Mountains, but easily identified by the smaller flower, less robust habit of growth, and probably always shorter life-span; the prostrate and quite different var. *semotus*, found at greater elevations, which need not concern us; and var. *variabilis* itself which extends north to Owens Lake in southern Inyo County, and is represented there by a winter-annual form with much shorter (even though silvery) pubescence, short calyx-teeth, and relatively small flowers which are symptomatic of intergradation into var. *Fremontii*. From specimens seen when only a few months old, I thought the petals to be paler than is usual in var. *Fremontii* or var. *variabilis*, whitish or ochroleucous tinged with pinkish-lavender in the distal half or third. The variety is associated with *Ectospermum Alexandrae* Swallen and *Oenothera deltoides* subsp. *eurekensis* Munz & Roos, described from the same place. The evening-primrose, interestingly enough, is perennial as is var. *micans* although derived from a species usually annual or monocarpic, or at least of short duration. As pointed out in the original description, var. *micans* is the most robust and long-lived among nearly related forms of the freckled milk-vetch.

289zf. *ASTRAGALUS LENTIGINOSUS* var. *BORREGANUS*

Commonly winter-annuals with a single stem either simple or branched from near the base, but sometimes persisting into a second year and then forming bushy clumps of several or even many stems erect and ascending from an indurated root, densely pubescent throughout with short, subappressed and some longer, narrowly ascending, straight or partly sinuous hairs up to 0.55–0.9 (1.2) mm. long, silvery-silky throughout or the leaves sometimes greenish-gray in age; *stems* stout or quite slender, flexuous, 1–3 dm. long; *leaves* 6–10 (16) cm. long, with (7) 15–19 broadly obovate-cuneate to elliptic-oblongate, obtuse or emarginate to retuse, flat or loosely folded leaflets 4–14 (21) mm. long; *peduncles* stiffly erect or somewhat incurved, 5–10 cm. long; *racemes* loosely, sometimes remotely 13–35 (48)-flowered, the axis early elongating, (4.5) 6–18 (26) cm. long in fruit; *calyx* 5.2–6.6 mm. long, densely strigulose-villosulous with white and often some fuscous or black hairs, the tube 4–5.1 mm. long, 2.5–3.5 mm. in diameter, the subulate or triangular teeth 1–2.3 mm. long; *petals* pink-purple; *banner* ovate-cuneate, broadly notched, 12–14.8 mm. long, 7–9.4 mm. wide; *wings* 11.3–14.4 mm., the claws (3.9) 4.3–5.5 mm., the blades 7.4–9.3 mm. long; *keel* 10.4–12.5 mm. long, the claws 4.3–5.7 mm., the blades 6–7.3 mm. long, 2.7–3.7 mm. wide; *pod* erect or incurved-ascending at a narrow angle, lanceolate or narrowly ovate-acuminate in profile, gently incurved, 1.5–2.3 cm. long, 4.5–6 mm. in diameter, slightly turgid but not or scarcely inflated, the subterete body shallowly sulcate along both sutures, passing gradually into the shortly triangular, cuspidate beak, the thin, greenish-stramineous or faintly mottled valves commonly concealed by a dense coat of silky, strigulose-villosulous hairs, becoming papery, finely reticulate, inflexed as a complete or nearly complete septum; *ovules* (10) 13–20.—Collections: 31 (iv); representative: *A. & R. Nelson 1288* (NY, SMU, UC); *Ripley & Barneby 3360* (CAS, POM), 10,087, 10,092 (CAS, RSA); *C. B. Wolf 10,236* (CAS, NY); *Johansen & Ewan 7142* (POM); *MacDougal 86* (NY); *Raven 11,637* (NY).

Sandy flats and semistabilized dunes, with *Larrea*, locally abundant after rains but scarce or absent in dry seasons, from 100 feet below to 800 feet above sea level, southern Colorado Desert, California, in eastern San Diego and Imperial Counties, east into the Yuma Desert in extreme southwestern Arizona and adjoining northwestern Sonora (presumably also northeastern Baja California);

apparently disjunctly at 900–2500 (3000) feet in the Mohave Desert, from near Baker and Kelso to Ivanpah Valley, eastern San Bernardino County, California.—Map No. 132—Late February to May.

ASTRAGALUS LENTIGINOSUS var. *BORREGANUS* (of Borrego Springs) Jones, Contrib. West. Bot. 8: 3. 1898 ("*Borreganus*").—Collected at Borregos Springs, Southeastern California, by Orcutt.—Holotypus, collected by T. S. Brandegee, not by Orcutt, April 16, 1895, UC! isotypus (fragm.), POM!

Astragalus Coulteri (Thomas Coulter, 1793–1843, Irish physician and naturalist, first botanical explorer of the Colorado Desert) Bth., Pl. Hartw. 307. 1848.—"Juxta Monterey legit Coulter."—Holotypus, *Coulter 431*, labeled "Monterey" but collected probably near the mouth of the Gila River in 1832, K (herb. Bth.)!—*Tragacantha Coulteri* (Bth.) O. Kze., Rev. Gen. 944. 1891. *A. lentiginosus* var. *Coulteri* (Bth.) Jones, Contrib. West. Bot. 8: 4. 1898, quoad nom. *Cystium Coulteri* (Bth.) Rydb. in Bull. Torr. Club 40: 50. 1913.

Astragalus Arthu-Schottii (Arthur Schott, 1814–1875, naturalist with the Mexican Boundary Survey) Gray in Proc. Amer. Acad. 6: 209. 1864, emend. Barneby in Proc. Calif. Acad. Sci. IV, 25: 158. 1944.—"... on the Mohave River, April 23, Fremont. Diluvial banks of the Colorado near its mouth, March 12, A. Schott. Boca Grande, Capt. E. K. Smith."—Lectotypus (Barneby, l.c.), *Mexican Boundary Survey No. 256*, collected by Schott in 1855, GH! isotypi, variously labelled "Colorado Desert near Fort Yuma," "Sonora on the Colorado del Oeste," and "between San Diego and the Colorado," F, NY, US!

Astragalus agninus (of lambs, or of Lamb Springs, a translation from the Spanish *borrego*) Jeps., Man. Calif. 577. 1925.—"Borrego Sprs., w. Colorado Desert (Jepson 8883, type)."—Holotypus, UC-JEPS! isotypus, NY (fragm.)!—*Cystium agninum* (Jeps.) Rydb. in N. Amer. Fl. 24: 408. 1929.

The varieties of freckled milk-vetch described up to this point have in common a pod either consistently inflated and bladderly or so often so that one little-swollen can be overlooked in practice as a rare minor variant. With var. *borreganus* I begin to take up those in which the pod is characteristically uninflated and varies from lanceolate to linear-oblong or fusiform in profile. Although these forms are here arranged side by side at the end of the species, as though a narrow pod signified a close interrelationship, it is likely that they arose separately by parallel mutations from different sources in the *A. lentiginosus* complex. The var. *borreganus* is almost certainly derived from a common precursor with var. *coachellae* and var. *variabilis*. Although very distinct upon first sight, because of the long, open racemes of narrow, white-silky pods, it is very close to var. *coachellae*. I have mentioned elsewhere and illustrated (1945, p. 132, Pl. IV, fig. 20) a collection from Imperial County, unquestionably of this entity, which bears a moderately swollen pod and can scarcely be separated from the silky-pubescent phase of var. *variabilis* found on the central Mohave Desert. It is generally true of var. *borreganus* that it differs from var. *coachellae* in having a root more often annual and a raceme averaging longer and looser; while the ovules are decidedly fewer, and the flower, although of nearly the same length, is somewhat differently proportioned, with a calyx shorter and keel longer in relation to the banner. In fine detail the flower is more nearly that of var. *variabilis*, and it is hardly surprising that Gray, who had seen pods of neither, associated the first collections of the two varieties in his description of *A. Arthu-Schottii*.

Unless it is by accident that we have no evidence of its presence in stations intermediate between the two foci of abundance in the eastern Mohave and southern Colorado Deserts, the Borrego milk-vetch has an unusual, decidedly bicentric pattern of dispersal. Possibly two races are involved; if so, it would be no surprise to learn that these arose separately, the eastern one, composed of plants normally coarser than the southern one, from var. *variabilis* and the other from var. *coachellae*. Further field observation and reappraisal of the herbarium record may throw light on this speculation.

For discussion of the synonym *A. Coulteri*, see under var. *coachellae*.

289zg. *ASTRAGALUS LENTIGINOSUS* var. *MARICOPAE*

Perennial but apparently not of long duration, appearing glabrous, the stramineous or purplish stems truly so, the leaf-rachises and inflorescences thinly strigulose with subappressed, pale or black hairs up to 0.5–0.8 mm. long, the herbage green or subglaucous; stems several, incurved-ascending, 3–4 dm. long, simple or spurred at 1–3 nodes preceding the first peduncle; leaves (4) 6–16 cm. long, with 17–25 ovate, broadly oval, oblong-elliptic, or (in some lower leaves) obovate-obcordate, obtuse and mucronulate or emarginate, flat, thick-textured

leaflets (3) 5–22 mm. long; *peduncles* stout, erect, 5–14 cm. long, shorter than or equaling the leaf; *racemes* loosely 13–30-flowered, the axis (3) 5–20 cm. long in fruit; *calyx* 7.2–8.6 mm. long, thinly black- or partly white-strigulose, the tube 5.6–6.4 mm., the teeth 1.6–2.6 mm. long; *petals* ochroleucous, immaculate; *banner* 15–16.5 mm. long; *wings* 12.8–14.2 mm., the blades 7.6–9 mm. long; *keel* 11.2–12 mm., the blades 5.8–6.3 mm. long, 2.6–3 mm. wide; *pod* ascending, narrowly oblong- or linear-ellipsoid, very slightly incurved, 2–3 cm. long, 3.7–5 mm. in diameter, not inflated, cuneate at base, contracted distally into a narrowly triangular-acuminate, unilocular beak 3–5 mm. long, the body subterete, carinate ventrally by the prominent suture, the somewhat fleshy, green, glabrous valves becoming leathery or stiffly papery, stramineous, almost smooth, the septum narrow but complete; *ovules* 22–26.—Collections: 5 (o); representative: *Peebles, Harrison & Kearney 3684* (ARIZ), *5238* (ARIZ); *Gooding Sel. 8-41, 9-41* (RM).

Stony washes and roadsides, 1100–2300 feet, known only from the middle Gila Valley in Maricopa County (Cave Creek; Fish Creek; Tempe), Arizona.—Map No. 131.—March to May.

ASTRAGALUS LENTIGINOSUS var. MARICOPAE (of Maricopa County) Barneby in Leaflet West. Bot. 4: 140. 1945.—“Type. Roadside near Tempe, Maricopa County, Arizona, G. J. Harrison No. 1790 . . .”—Holotypus, collected May 4, 1926, US!

The var. *maricopae* is intermediate in some respects between var. *yuccanus* and var. *Wilsonii*, which are found short distances to the north and west in Arizona. The slenderly fusiform or subcylindric, uninflated pod is like that of var. *Wilsonii*, but the long, open racemes of somewhat smaller, cream-colored flowers distinguish it at a glance. The size and color of the flowers are more nearly in agreement with var. *yuccanus*, but they average a trifle larger and the petals are more strongly graduated. The ovule-number is nearly the same in var. *yuccanus* and var. *maricopae*, but the pod of the former is bladdery-inflated. The variety differs from var. *australis*, the pod of which is sometimes little inflated, in its ochroleucous petals and very narrow, terete fruit.

289zh. ASTRAGALUS LENTIGINOSUS var. PALANS

Perennial, sometimes of short duration, thinly strigulose with appressed or subappressed hairs up to 0.45–0.7 mm. long, the herbage green or yellowish-green, the leaflets glabrous above or on both sides, exceptionally pubescent on both sides; *stems* several, erect or incurved-ascending, commonly stout and purplish, (1) 1.5–3.5 (4) dm. long; *leaves* (3.5) 5–11 cm. long, with 13–21 (23) broadly obovate-cuneate, oblong-elliptic, more rarely oblong-oblancheolate or (especially in some lower leaves) suborbicular-obcordate, obtuse, emarginate, or subacute, flat or loosely folded leaflets (3) 5–17 (26) mm. long; *peduncles* erect or incurved, much shorter than or equaling the leaf; *racemes* (6) 10–28-flowered, the axis either scarcely or greatly elongating, (1) 2–12 (14.5) cm. long in fruit; *calyx* 6.3–9.4 mm. long, either white- or black-strigulose, the cylindric or deeply campanulate tube 4.7–6.8 mm. long, 2.4–3.6 mm. in diameter, the teeth (0.9) 1.1–3 (4) mm. long; *petals* purple; *banner* broadly obovate-spatulate, rhombic-obovate, or -oblancheolate, 13.5–17.5 (18.3) mm. long, 6.8–10 mm. wide; *wings* 11.8–16.8 mm., the claws 5.4–7.3 (8) mm., the blades 6.9–10.2 (12) mm. long; *keel* 10.1–15 (15.3) mm. long, the claws 5.4–7.5 mm., the blades 5.8–9 mm. long, 2.5–3.6 (3.8) mm. wide; *pod* spreading, declined, and thence incurved-ascending, or ascending at a wide angle, obliquely linear-lanceolate to narrowly ovate-acuminate in profile, nearly straight to lunately or hamately incurved, (1.2) 1.5–2.7 cm. long, 4–7.5 mm. in diameter, subterete to somewhat laterally compressed when little curved, dorsiventrally so when greatly curved, contracted distally into a triangular-acuminate, long-cuspidate, unilocular beak about 5–8 mm. long, the some-

what fleshy, green or brightly mottled, glabrous or less often strigulose valves becoming leathery or stiffly papery, stramineous or finally blackish, inflexed as a complete or subcomplete septum 1.4–2.5 mm. wide; *ovules* 20–42.—Collections: 40 (ix); representative: *W. A. Weber* 3840 (CAS), 4735 (CAS, SMU, TEX, WS); *J. T. Howell* 24,752 (CAS, RSA); *Barneby* 12,753 (CAS, NY, RSA), 12,785 (CAS, RSA), 13,105, 13,127 (CAS, NY, RSA); *Jones* 5215e (NY, POM), 5218 (F, GH, NY, POM, UC); *Eastwood* 5748 (F, GH); *Lemmon* (from Fort Mohave) in 1884 (GH, US), 3326 (GH); *Clover* 6079 (CAS).

Open mesas, sandy rock-ledges and canyon-terraces, rocky washes, and alkaline sandy flats, mostly 4000–7000 feet, on sandstone, sometimes on limestone, perhaps occasionally on granitic or volcanic bedrock, usually in piñon-juniper forest, locally plentiful in scattered stations in the Colorado Basin south of Tavaputs Escarpment in southwestern Colorado, southeastern Utah, and northern Coconino and Navajo Counties, Arizona, westward to the Grand Canyon; also at lower elevations ($\pm$ 2500 feet and possibly down to 1000 feet) in the Virgin Valley, Washington County, Utah, and along the Colorado River below Grand Canyon in northern Mohave County, Arizona.—Map No. 131.—April to June.

ASTRAGALUS LENTIGINOSUS var. *PALANS* (Jones) Jones, Contrib. West. Bot. 8: 4. 1898, based on *A. palans* (straggling) Jones in Zoë 4: 37. 1893.—“Montezuma Cañon, Utah, June 1, 1892, coll. by Miss Alice Eastwood.”—Holotypus, POM! isotypi, CAS, GH, MO (dated “May 29”), NY (fragm.), UC!—*Tium palans* (Jones) Rydb. in N. Amer. Fl. 24: 397. 1929.

Astragalus amplexus (encircling) Pays. in Bot. Gaz. 60: 378. 1915.—“... on dry hillsides in Long Park near Naturita, May 22, 1914; alt. about 6000 ft. ... no. 335.”—Holotypus, RM! isotypus, NY!—*Hamosa amplexa* (Pays.) Rydb., Fl. Rocky Mts. 496, 1063. 1917. *Tium amplexum* (Pays.) Rydb. in N. Amer. Fl. 24: 398. 1929.

To those who have become familiar with the freckled milk-vetch through its commoner manifestations on the deserts of California or in the Great Basin, the inclusion of var. *palans* in the *A. lentiginosus* complex comes at first as a disagreeable or even unacceptable surprise. However its close relationship is quickly comprehended as its various phases are encountered, and is reflected in the mere existence of such a combination as *A. palans* var. *aranosus*, proposed by the botanist most intimately concerned with the discovery and description of these and allied forms. The great variation in the pod of var. *palans* has been emphasized and illustrated elsewhere (Barneby, 1945, p. 135, Pl. IV, figs. 23–26) but is so important to an understanding of the variety's circumscription that it can be mentioned again without apology. The fruit varies from slenderly fusiform and straight or almost so to incurved through about a half-circle. A comparatively short, little-incurved, clawlike pod, which ascends from the raceme, closely resembles the least-swollen states of var. *araneosus* or var. *diphysus*. Curvature commonly becomes more pronounced with increasing length and leads to the extreme (nomenclaturally typical) phase in which the pod is technically declined from an arched pedicel but so strongly bent inward that the tip is brought into a more or less vertical attitude. In addition to the variation in outline, the valves may be brightly mottled with red or purple, green and concolorous, or green suffused with red, and may be either glabrous or (as in the typus of *A. amplexus*) strigulose. The mode of compression also varies greatly, and the transverse section may be round, round and emarginate at either one or both sutures, or decidedly obcordate. Like many species which consist of populations isolated one from the other by barriers to migration as effective as the deeply sculptured canyons of the Colorado Plateau, var. *palans* consists of numerous races differing further in density and distribution of the pubescence, size of flowers, and length of fruiting raceme. Until the patterns of variation and geographic dispersal have been compared in greater detail than is possible at present, it cannot be foretold whether the polymorphic concept adopted in these pages may yield or not to further elaboration. In this connection the populations in northwestern Arizona, remarkable for their straight erect or ascending pod and leaves pubescent on both sides, will deserve special scrutiny (cf. *Lemmon* 3116, 3326, wrongly referred in my revision to var. *mokiensis*). It is also conceivable that *A. Bryantii*, referred for technical reasons to another section of the genus, may prove to be an anomalous offshoot of the same group of forms.

289zi. *ASTRAGALUS LENTIGINOSUS* var. *URSINUS*

Presumably perennial, the root unknown, the stems apparently erect, $\pm$ 1.5–3 dm. long, strigulose and zigzag distally, the herbage green, subglabrous, thick-

textured; *leaves* (3) 4–9 cm. long, with 13–17 obovate or oblong-obovate, obtuse or retuse leaflets 5–11 mm. long; *peduncles* erect, $\pm$ 4–6 cm. long; *racemes* loosely 12–20-flowered, the axis 3.5–6 cm. long in fruit; *calyx* $\pm$ 4.7 mm., the tube 3 mm. long, 2.2–2.5 mm. in diameter, the broadly subulate teeth 0.8 mm. long; *petals* purple; *banner* $\pm$ 12 (15?) mm. long, 6 mm. wide; *wings* 10.5–11.5 mm., the blades $\pm$ 6.5 mm. long; *keel* 8.5–10 mm., the blades $\pm$ 4.3–5 mm. long, 2.4 mm. wide; *pod* lance-oblong in profile, slightly incurved, 1–1.3 cm. long, 3.5–4.5 mm. in diameter, subterete, scarcely turgid, the unilocular beak $\pm$ 2.5 mm. long, the complete or semicomplete septum 2–2.5 mm. wide, the valves leathery, glabrous; *ovules* $\pm$ 22–24.—Collections: 1 (the typus).

Habitat unknown, but probably at low or middle elevations, seen only at the type-locality in Bear Valley, "southcentral" Utah, probably in Iron or Garfield County.—Not mapped.—May or June (?).

ASTRAGALUS LENTIGINOSUS var. URSINUS (Gray) Barneby in Leaflet West. Bot. 4: 133, Pl. IV, figs. 31–33. 1945, based on *A. ursinus* (of bears, from Bear Valley) Gray in Proc. Amer. Acad. 13: 367. 1878.—"Bear Valley in south-central part of Utah, Dr. Palmer, 1877."—Holotype, GH! isotypi, K, NY!

So far as can be judged from the type-specimens, var. *ursinus* is very closely related to var. *palans*, of which it may be no more than a form with exceptionally small flowers and short, ascending fruits. Palmer's Bear Valley has not been identified with any certainty, but is presumed to be the valley of Bear Creek, a small west affluent of the Sevier River which rises in the Panguitch Mountains east of Parowan. After flowing about 15 miles in a northeasterly direction through eastern Iron County, Bear Creek turns abruptly southeast and in the course of some 6 miles or less joins the Sevier at Orton Ranch in western Garfield County.

289zj. ASTRAGALUS LENTIGINOSUS var. WILSONII

Perennial, stout or sometimes quite slender, the prostrate, decumbent or weakly ascending stems 2–5 dm. long, subglabrous, purplish, the herbage green or subglaucous, the leaflets glabrous above or on both sides, at most puberulent beneath, the few, scattered hairs on the rachis and inflorescence straight, appressed or subappressed, up to 0.5–0.75 mm. long; *leaves* (3.5) 6–16 cm. long, with (11) 17–25 ovate, broadly elliptic, or oblong-obovate, obtuse or emarginate, flat, often faintly veined leaflets (4) 6–20 (25) mm. long; *peduncles* incurved-ascending, 2.5–7 cm. long, shorter than the leaf; *racemes* shortly (7) 10–17 (22)-flowered, the axis not or scarcely elongating, 1.5–4 (6) cm. long in fruit; *calyx* (7) 7.7–9.4 mm. long, thinly white-, black- or partly black-strigulose, the deeply campanulate or cylindric tube (5.5) 5.7–7.7 mm. long, 2.7–3.8 mm. in diameter, the teeth 1.5–3 mm. long; *petals* either white with keel-tip faintly pink-tipped, or all suffused with pinkish-lavender, the color fugitive; *banner* (14.2) 15–20 mm. long, 8–10 mm. wide; *wings* (13) 14.8–17.4 mm., the claws (5.5) 5.7–7.8 mm., the blades 8.4–10.5 mm. long; *keel* (11.6) 12.8–15 mm. long, the claws 5.7–7.8 mm., the blades 6.3–8 mm. long, 2.7–3.4 mm. wide; *pod* usually ascending, more rarely horizontal, narrowly lance-acuminate in outline, scarcely inflated or rarely (transition to var. *vitreus* or var. *oropedii*?) moderately so and narrowly ovoid-acuminate, nearly straight or gently incurved, (1.5) 2–3.5 cm. long, 3.8–7 (9) mm. in diameter, narrowed upward into a narrowly triangular-acuminate, unilocular beak 5–10 mm. long, commonly sulcate along both sutures, the green or more often mottled, glabrous or rarely puberulent valves becoming stiffly papery, stramineous or brownish, the almost complete septum 1.4–2.5 mm. wide; *ovules* (29) 32–41.—Collections: 16 (ii); representative: *MacDougal* 140 (F, GH, NY, POM, UC); *Rusby* 586 (NY); *Deaver* 1935 (CAS); *Barneby* 12,654 (CAS, RSA), 12,659 (CAS, NY, RSA).

Open slopes and flats in yellow pine forest and descending along canyons

into oak chaparral and juniper forest, sometimes on sandy ridges among *Canotia*, (3000) 3500–7000 feet, in soils of volcanic origin, locally plentiful on the Flagstaff Plateau and headwaters of the Verde River in southwestern Coconino, northwestern Gila and eastern Yavapai Counties, Arizona.—Map No. 131.—(February) March to June.

ASTRAGALUS LENTIGINOSUS var. *WILSONII* (Greene) Barneby in Leaf. West. Bot. 4: 139, Pl. IV, figs. 27–30. 1945, based on *A. Wilsonii* (Norman C. Wilson, —) Greene in Pittonia 3: 196. 1897.—“Collected in northern Arizona, May, 1893, by Norman C. Wilson.”—Holotypus, collected near Flagstaff, Coconino County, ND (2 sheets, *Herb. Greene. 27583, 4*)! —*Tium Wilsonii* (Greene) Rydb. in N. Amer. Fl. 24: 398. 1929 (“*Wilsonii*”).

It is difficult at first sight to reconcile Wilson's freckled milk-vetch with a generalized concept of *A. lentiginosus*. However, it is only necessary to compare flowering specimens of var. *Wilsonii* from near Flagstaff and of var. *oropedii* from the Kaibab to become aware of a close relationship between two forms, adapted to similar environments but vicariant in range, which differ importantly only in the degree of the pod's inflation. With the exception of var. *diphysus*, which differs in its bright purple flowers and swollen, inversely pear-shaped or almost globose fruits, the var. *Wilsonii* is the only freckled milk-vetch known to occur within the boundaries of its area of dispersal. It is easily recognized by its narrowly lanceolate, subterete legumes divided by a septum into separate chambers. It is only poorly distinguished from var. *palans* by its white or faintly pink-tinged and not bright pink-purple flowers, and its taxonomic status will require reappraisal as materials of vars. *palans* and *ursinus* accumulate.

At the time of my revision (1945, l.c.) all the material of var. *Wilsonii* at my disposal was from the rim of the San Francisco Plateau and from canyons in the escarpment at elevations unrecorded, and I presumed that it was a plant characteristic of open pine woods, as at Cosnino, but this proves to be only sometimes true. The variety has since been traced down to the floor of the Verde Valley, where it is found on soft volcanic rocks which weather to alkaline sandy clays, and it now appears to be more abundant in the *Quercus-Canotia* and chaparral belts than in xeric pine forest on the plateau. The material from lower elevations has pods less brightly mottled and apparently a little more fleshy (and, in consequence, firmer when dry) than the nomenclaturally typical form.

A remarkable plant from near Cameron, Coconino County (*Marjorie Glendenning in 1950*, CAS) must be mentioned. It combines the large flowers of var. *Wilsonii* with the looser raceme and swollen fruit of var. *vitreus* or var. *oropedii*. I am uncertain as to its taxonomic status.

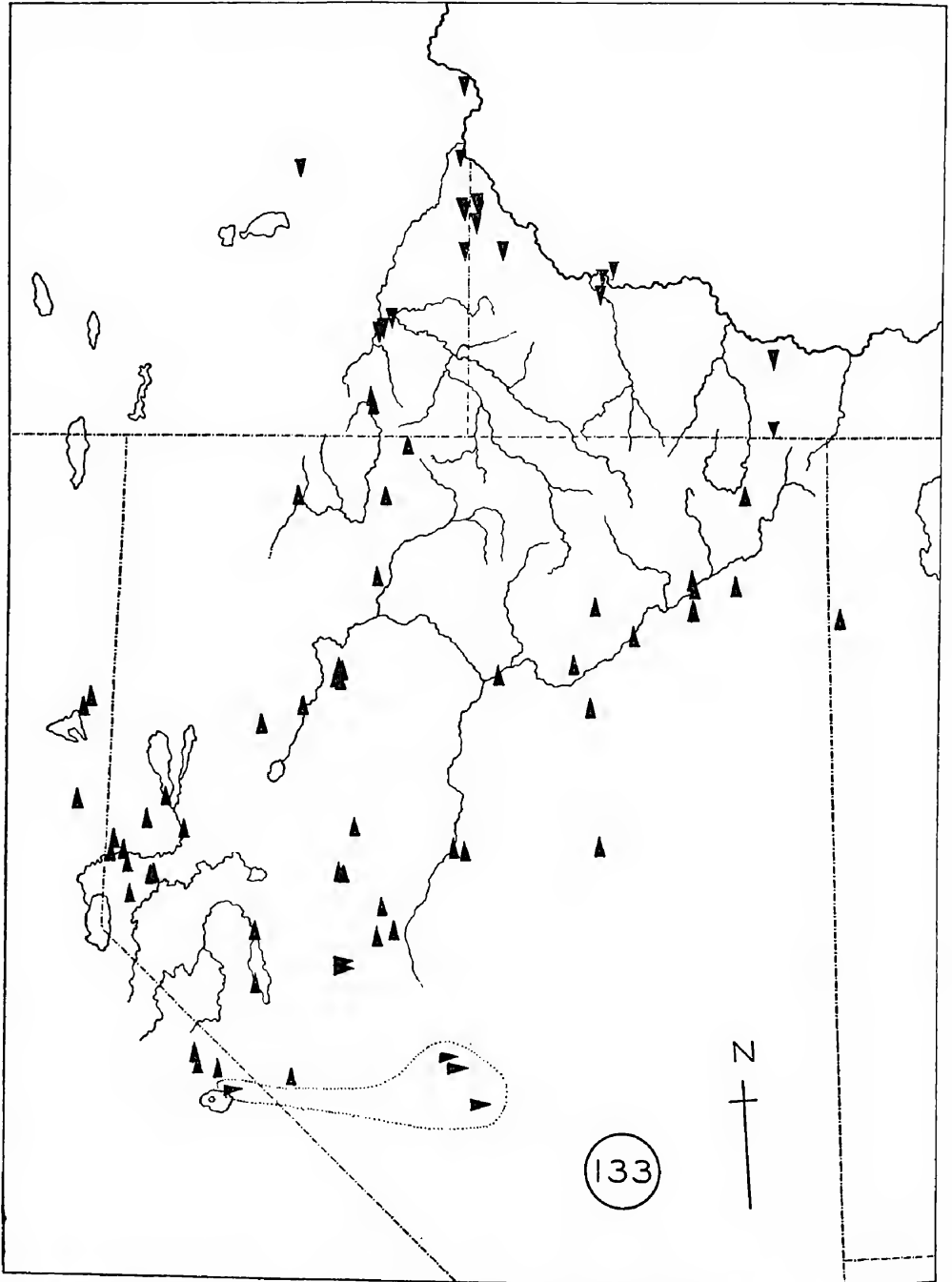
290. *ASTRAGALUS IODANTHUS*

Low, diffuse, caulescent perennial, with a woody taproot and shortly forking or knotty caudex, more or less densely strigulose with straight, appressed or narrowly ascending, filiform (or largely shorter, flattened, somewhat scalelike) hairs up to 0.3–0.6 (0.7) mm. long, exceptionally villosulous with ascending and incurved or curly hairs, the herbage green or cinereous, the leaflets nearly always glabrous above; *stems* several, about 4–12 in mature plants, (3) 5–35 cm. long, prostrate or decumbent, simple or commonly spurred or shortly branched at 1–3 (5) nodes preceding the first peduncle, floriferous from below or above the middle, sometimes abruptly zigzag distally; *stipules* membranous or the uppermost thinly herbaceous, 2–6 mm. long, the lowest loosely imbricated or shortly discrete, semi-to almost fully amplexicaul, the median and upper ones progressively narrower, with triangular or lance-acuminate, rarely ovate, usually squarrose or deflexed blades; *leaves* (2) 3–7 cm. long, all petioled but the uppermost shortly so, with (7) 9–21 broadly obovate, oblong-obovate, or obovate-cuneate, rarely oblong-oblancoate, elliptic, or suborbicular, mostly retuse or truncate, sometimes obtuse and mucronulate, flat or loosely folded leaflets (3) 5–15 (18) mm. long; *peduncles* ascending, sometimes at a wide angle, straight or incurved, (1) 2–4.5 cm. long, shorter than the leaf; *racemes* at first rather compact, early loosening, 7–17 (21)-flowered, the flowers at full anthesis widely ascending or spreading, declined thereafter, the axis (0.5) 1–4.5 (7.5) cm. long in fruit; *bracts* membranous, ovate, ovate-acuminate, or lanceolate, 1–3 mm. long; *pedicels* at first straight

and ascending, at length arched out- or downward, at anthesis (0.3) 0.7–1.5 mm., in fruit thickened, (0.8) 1–2 mm. long, persistent; *bracteoles* usually 2, at base of calyx or just below it, minute or up to 1 mm. long, quite often 0; *calyx* 3.3–8 mm. long, thinly or densely strigulose (villosulous) with black or black and white hairs, the disc subsymmetric, the tube varying from shortly campanulate to sub-cylindric, the subulate teeth usually less than half as long as the tube, the whole becoming papery, marcescent, ruptured or not; *petals* purple, whitish with purple keel-tip, or all cream-colored; *banner* recurved through $\pm 45^\circ$, 9–15 mm. long, with either short- or long-cuneate claw and ovate, shallowly notched blade 5.3–8.5 mm. wide; *wings* either as long or decidedly shorter, the blades oblong-oblancheolate or linear-oblong, obtuse or truncate, nearly straight; *keel* nearly equaling to much shorter than the banner, the broadly lunate blades gently incurved through $45\text{--}55^\circ$ to the very obtuse apex; *anthers* 0.45–0.65 (0.7) mm. long; *pod* essentially declined but often apparently spreading from humistrate peduncles or, when disturbed in pressing, deciduous from a minute boss on the receptacle, in outline very obliquely lanceolate, linear-lanceolate, or elliptic, 1.5–4 cm. long, (2.5) 3–8.5 mm. in diameter, commonly straight or a trifle arched downward in the lower half or third, then abruptly incurved through at least 90° and more commonly through 180° (and thus hamate), or sometimes more gently and yet further incurved so as to become annular or even coiled, either cuneate or long-acuminate into the ultimately obtuse base, acuminate distally into a laterally flattened, rigidly long-cuspidate beak, very variably compressed in 3 principal (but intergrading) modes: 1) strictly dorsiventral, with 2 nearly flat faces and narrow but obtuse lateral angles, the ventral face then low-carinate by the prominent suture; or 2) triquetrous, the lateral faces then either flat, low-convex, or slightly concave and the dorsal face widely and openly sulcate; or 3) compressed-triquetrous, the dorsal sulcus comparatively narrow; in any case the green, often red-mottled, somewhat fleshy, strigulose valves becoming stramineous or purplish, leathery or stiffly papery, cross-reticulate, either not inflexed or more often narrowly so, the septum 0.2–1.5 mm. wide, extending from base to below the middle of the pod, up to the middle, rarely up to the base of the unilocular beak; *dehiscence* apical, through the gaping beak, and often also tardily basal; *ovules* 14–30; *seeds* brown, purplish-brown, or almost black, smooth or rugulose-punctate, dull or lustrous, 2.2–3.5 mm. long.

When Watson described *A. iodanthus*, he interpreted it as closely related to *A. Beckwithii* and *A. Parryi*, and aligned it with these species in a loosely defined sect. *Argophylli*. This opinion of its affinities was accepted by Jones who (1923, p. 203) placed *A. iodanthus* next to *A. cibarius* in his expanded section of the same name; and later Rydberg (1929) based the heterogeneous *Xylophacos* sect. *Iodanthi* upon it. It has always been assumed that the pod of *A. iodanthus* is unilocular, an important generic character of *Xylophacos*, but at least two out of three examples of the fruit possess a perfectly normal, even though narrow, partial septum. One plant of this type (*Stretch* 265, NY) was referred by Rydberg to *A. (Hamosa) drepanoloba* (= our *A. diaphanus*), from which circumstance the epithet *diaphanoides* was chosen later for one variant of the species. Although the development of a septum is no longer regarded as of great phylogenetic significance, *A. iodanthus* is properly excluded from sect. *Argophylli* on other grounds. It has no close relative in that group as circumscribed in these pages, but it is not easy to exclude by technical characters. On the other hand, it is often difficult or even impossible to separate flowering material of its various forms from the polymorphic *A. lentiginosus*, from which it differs principally in a tendency to dorsiventral and triquetrous compression of the fruit, which is never inflated and commonly very strongly incurved. In *A. lentiginosus* there are many examples of little-inflated pods, some varieties being characterized by a fruit of this nature, while others put out occasional forms with narrow, clawlike pods quite similar to that of *A. iodanthus*, except that the section is subterete or didymous rather than triangular or transversely oblong. The pod of *A. iodanthus* is essentially deflexed, even though so greatly incurved as to bring its beak into an erect plane parallel with the raceme-axis, whereas in most forms of *A. lentiginosus* it is ascending or spreading. However in *A. lenti-*

ginosus var. *palans*, the lance-ellipsoid, little-inflated pod varies from erect to decurved and its section varies from round to triangular, so that sometimes the only technical differential character that remains is the broader septum. The forms of *A. lentiginosus* most closely resembling *A. iodanthus* in habit, var. *lentiginosus* and var. *platyphyllidius*, produce now and again a phase remarkable for the so-called "carinate" flower, in which the petals are little- or poorly graduated and the keel becomes relatively broad and prominent. A flower of this sort is found



Map No. 133. Nevada and parts of adjoining states. Range of *A. iodanthus*: ▲ var. *iodanthus*; and ▼ var. *vipereus*; and of ◆ *A. pseudiodanthus*.

frequently in *A. iodanthus* and is, in fact, characteristic of its var. *vipereus*.

In the original publication Watson mentioned a form of *A. iodanthus*, found near the Great Salt Lake in Utah, which differed from the Nevadan type in its more leathery, less incurved, incipiently septiferous pod. In reality this was the perfectly distinct species *A. cibarius*, superficially similar to *A. iodanthus* in habit of growth but differing importantly in its shortly stipitate, emmenoloboid fruit. In modern accounts of the genus, the two are traditionally associated but are not at all closely related. Now referred to sect. *Malaci*, *A. cibarius* has not been contrasted directly with *A. iodanthus*, but since they are still sometimes confounded and are likely to be so where their ranges overlap in eastern Nevada, the following key may be of practical value:

1. Pod truly sessile, deciduous from a conical receptacle and dehiscent on the ground, nearly always incurved or abruptly hooked through a half-circle or more; *lower stipules* small and inconspicuous; Nevada to s.-w. Idaho, s.-e. Oregon, and transmontane California *A. iodanthus*
1. Pod contracted at base into a short, thick stipe (concealed by the marcescent calyx), dehiscent in situ or deciduous together with the pedicel, straight or gently incurved through $\frac{1}{2}$ -circle; *lower stipules* large, broad, ovate or obovate, obtuse and veiny, very conspicuous; Utah and e. Nevada to s.-e. Idaho, w. Montana, s. Wyoming, and w. Colorado *A. cibarius*

Like its relative *A. lentiginosus*, the present species is both polymorphic and variable, especially so in the form, size, and coloring of the flowers and in the curvature and compression of the fruit. Setting aside what seem to be trivial, however conspicuous minor variants, it is possible to distinguish one principal dichotomy within the species corresponding with geographic dispersal:

Key to the Varieties of *A. iodanthus*

1. Flowers relatively large, the deeply campanulate or cylindro-campanulate tube of the calyx (3.4) 3.7–5 mm. long, the banner mostly 12–15 mm. long; *pod* relatively broad, when properly developed 5–8.5 mm. in transverse diameter; centr. and n. Nevada, n.-e. California, n.-w. Utah, and s.-e. Oregon s. of the Humboldt-Snake watershed 290a. var. *iodanthus*
1. Flowers smaller, the campanulate tube of the calyx 2.6–3.2 mm. long, the banner 9–11.5 mm. long; *pod* usually narrower, mostly 3.5–5 mm. in transverse diameter; Snake River drainage in s.-e. Oregon and s.-w. Idaho 290b. var. *vipereus*

290a. *ASTRAGALUS IODANTHUS* var. *IODANTHUS*

Usually thinly pubescent, the stems stramineous or pale green and nearly glabrous; *leaflets* (7) 11–19 (21), sometimes conspicuously white-ciliate; *calyx* (5) 5.5–8 mm. long, the disc 0.7–1.4 mm. deep, the tube (3.4) 3.7–5 mm. long, 2.1–2.7 mm. in diameter, the teeth (1.3) 1.5–3 mm. long; *petals* brilliant wine-purple (drying violet), lilac, or whitish with purple keel-tip, exceptionally cream-colored and concolorous; *banner* (10) 12–15.5 mm. long; *wings* 1–2.4 mm. shorter, the claws 4–6.3 mm., the blades (5.2) 6–8 mm. long, 1.7–2.3 mm. wide; *keel* 1–4.6 mm. shorter than the banner, 7.8–12 mm. long, the claws 4–6.1 mm., the blades 4.1–7.3 mm. long, 2.1–2.6 mm. wide; *pod* (2) 2.5–4 cm. long, (4.5) 5–8.5 mm. in diameter, variable in compression but most commonly more dorsiventrally than triquetrously flattened; *ovules* 18–30.—Collections: 60 (xv); representative: *M & G. Ownbey* 2783, 2828 (CAS, NY, RSA, SMU, WS); *Munz* 11,908 (NY); *Maguire & Holmgren* 25,380 (NY, RSA, WS), 25,491 (NY, RSA); *Ripley & Barneby* 4559, 5921, 9354 (RSA).

Dry hillsides and valley floors, in loamy, sandy, or gravelly clay soils mostly on volcanic bedrock, nearly always among sagebrush, common and locally plentiful between 5000 and 7800 feet throughout the valley of the Humboldt River and its tributaries across the width of northern Nevada (south along the Reese River to northern Nye County), extending just into southeastern Oregon, northwestern Utah (western Tooele County), and the plains and Sierra foothills of eastern Lassen and Sierra Counties, California, and south through the hill-country of

westcentral Nevada to the east slope of the Sierra Nevada in Mono County, California; about the Humboldt and Carson sinks descending to barren, alkaline clay or sandy slopes and washes as low as 4000 feet, there associated with *Artemisia spinescens* and *Atriplex*.—Map No. 133.—April to early July.

ASTRAGALUS IODANTHUS (violet-flowered, the petals sometimes wine-purple, drying violet) Wats., Bot. King 70. 1871.—“Collected by Dr. Bloomer and Dr. Torrey near Virginia City, and not rare in the foothills of Western Nevada from the Virginia to the West Humboldt Mountains; 4500–6000 feet altitude . . . 269.”—Lectotypus, collected by Sereno Watson at 5000 ft. in the West Humboldt Mountains in June, 1868, US! isotypi, GH, NY!—*Tragacantha iodantha* (Wats.) Rydb. in Bull. Torr. Club 52: 144. 1925. *A. iodanthus* var. *typicus* Barneby in Leaff. West. Bot. 4: 49. 1944.

Astragalus iodanthus var. *diaphanoides* (resembling *A. diaphanus*, with which formerly confused) Barneby in Leaff. West. Bot. 4: 50, Pl. opp. p. 56, figs. 20–23. 1944.—“NEVADA: . . . between Reno and Dewey, Washoe Co. . . . Ripley & Barneby No. 5659 . . .”—Holotypus, collected June 10, 1943, CAS! isotypus, RSA!

The typical form of the Humboldt River milk-vetch, var. *iodanthus*, is very variable in vesture, in proportionate length and coloring of the petals, and in length and curvature of the legume. The various types of fruit, at first sight so remarkably disparate, represent individual variants of sporadic occurrence, but variation in other characters is, at least to some small degree, correlated with elevation and environment. The common form of var. *iodanthus* in the mountains, in protected spots in the sagebrush valleys, and elsewhere where the soil is rich or the exposure cool, is nearly glabrous up to the black-strigulose inflorescence and has relatively long, well-graduated petals of a bright claret-purple which turns violet on drying (but tends to fade after a year or two in the herbarium). In the low deserts of northwestern Nevada and in adjoining California, the prevailing form tends to be more densely strigulose, especially about the margins and midribs of the leaflets, and the petals, which vary from pale lilac to whitish or cream-colored, with keel tip either maculate or concolorous, are much less strongly graduated so that the keel appears large and prominent. A plant of the latter sort furnished the typus of var. *diaphanoides*, which is probably best interpreted as an ecotype without claims to taxonomic recognition. Both phases of the species are known to occur near the type-locality in the West Humboldt Mountains, Watson's original “violet-flowered” phase (with brightly mottled pod) in the juniper-sagebrush association between 5600 and 6300 feet, and possibly higher on Star Peak, the lowland phase with pale flowers and faintly mottled or green pods in the foothill canyons at about 4700 feet. When var. *diaphanoides* was described, it was noted that the valves of the pod, in contradistinction to those of typical var. *iodanthus* as there conceived, are often inflexed through the lower half or more as a narrow but evident septum, but a similar and sometimes even wider septum has since been found on the same plants with a long, bright purple flower. The complete disappearance of the septum, especially from near the base of the pod where it is most easily overlooked, is rare in the species as a whole.

Another variant, remarkable in its way, has been collected in the Trinity Mountains, Pershing County, Nevada (Ripley & Barneby 5637, CAS, RSA); the vesture in these plants is composed of loosely ascending incumbent or curly hairs, suggesting a passage toward *A. pseudiodanthus*, which differs further, however, in its subterranean root-crown.

290b. *ASTRAGALUS IODANTHUS* var. *VIPEREUS*

Variable in pubescence, but the stems nearly always finely cinereous; *leaflets* (7) 9–13 (15), mostly broad and retuse; *calyx* (3.3) 3.7–5.3 mm. long, the disc 0.6–0.9 mm. deep, the shortly campanulate tube 2.6–3.2 mm. long, 1.7–2.6 (2.9) mm. in diameter, the teeth (0.6) 1–2.2 mm. long; *petals* pale lilac, the keel-tip commonly more deeply colored than the rest; *banner* 9–11.5 mm. long, 5.3–8.3 mm. wide; *wings* as long or not over 1 mm. shorter, the claws 2.4–3.7 mm., the blades 6–7.3 mm. long, 1.8–2.4 mm. wide; *keel* 7.8–10 mm. long, not over 1.5 mm. shorter than the banner, the claws 2.9–4.1 mm., the blades 5.4–7.1 mm. long, 2.3–3.1 mm. wide; *pod* (2) 2.5–3.5 (4) cm. long, (2.5) 3–5.5 (6) mm. in diameter, the compression mostly triquetrous; *ovules* 14–24.—Collections: 22 (v); representative: Peck 25,748 (RSA, WS), 25,943 (CAS, WILLU); W. H. Baker 10,206, 10,158 (ID, RSA); Christ 9553 (NY); Maguire & Holmgren 26, 241 (NY, RSA); Ripley & Barneby 6148 (CAS, RSA).

Barren stony hills, knolls, and gullied river bluffs, in stiff alkaline clay soils, 2600–4200 feet, locally common along the Snake, Bruneau, Malheur, and Owyhee Rivers, in Twin Falls, Elmore, and Owyhee Counties, Idaho, and adjoining Malheur County, Oregon.—Map No. 133.—April to June.

ASTRAGALUS IODANTHUS var. *VIPEREUS* (of snakes, or by extension, of the Snake River), var. nov., a var. *iodantho* floribus minoribus et legumine angustiori, ut supra descriptis, ab-similis.—IDAHO: on cobblestone bluffs near Bruneau, Owyhee County, alt. 2600 ft., May 31, 1945, Ripley & Barneby 6485.—Holotypus, CAS! isotypi, NY, IDS, RSA!

Even though no better quantitative character than the length of the calyx-tube is absolutely diagnostic of var. *vipereus*, it is unquestionably a distinct entity, with its own indefinable facies and a range disjunct from that of var. *iodanthus*. The first collections that came to my notice were identified as the now discarded var. *diaphanoides*, which they resembled in their weakly graduated or subequal petals, but the petals themselves are with few and irrelevant exceptions smaller and shorter, the leaflets usually less numerous, the stems more densely strigulose, and the pod nearly always narrower and more sharply trigonous. The differences between var. *iodanthus* and var. *vipereus* become impressive only when plants of comparable age and vigor are compared. It is a simple matter to pick out a few small and narrow pods, for example, from a starveling plant or a late raceme of var. *iodanthus* which fall below the average within the colony, and similarly an occasional fruit of var. *vipereus* which exceeds in width the norm for its kind. Such exceptions, narrowly interpreted, may appear at times to invalidate the differential criteria stressed in the key. As in the typical variety, the vesture of var. *vipereus* is variable in quality. Normally composed of straight, appressed hairs, it is occasionally curly and villosulous. The latter state is apparently rare, known at present only from the bluffs of the Owyhee River near Rome, Malheur County, where it is a constant feature of the local populations.

291. *ASTRAGALUS PSEUDIODANTHUS*

Diffuse, caulescent perennial, with a long, slender, vertical or oblique taproot and shortly forking or knotty, subterranean caudex, canescently villous nearly throughout with fine, ascending, incumbent, or curly hairs up to 1–1.2 mm. long, the stems mostly thinly so and greenish, the leaflets glabrous above; *stems* prostrate, radiating, forming loosely woven mats, 2–3 dm. long, buried for a space of 1–3 cm., divaricately branched at most nodes up to the first peduncle and thus tending to form flat, fan-shaped sprays, the branches sometimes largely replaced by peduncles and then floriferous nearly their whole length, flexuous or abruptly zigzag distally; *stipules* 2–5 mm. long, membranous or early becoming so, the lowest at length papery, fragile, irregularly deciduous, about semiamplexicaul, the upper ones with deltoid-acuminate or triangular, often reflexed blades; *leaves* 2.5–5 cm. long, shortly petioled or the upper ones subsessile, with (7) 11–19 rather crowded, obovate-cuneate, obtuse or retuse, loosely folded leaflets 3–10 mm. long; *peduncles* ascending or incurved, 2–3 cm. long; *racemes* (7) 12–25-flowered, subcompact becoming loose in age, the flowers at full anthesis spreading, declined thereafter, the axis elongating, 2–5 (8) cm. long in fruit; *bracts* membranous, ovate or ovate-acuminate, 0.6–1.5 mm. long; *pedicels* early arched out- and downward, at anthesis 0.5–1.1 mm., in fruit slightly thickened, 1.4–1.8 mm. long, persistent; *bracteoles* 0; *calyx* 3.8–4.7 mm. long, villosulous with black and white or largely white hairs, the subsymmetric disc 0.7–0.8 mm. deep, the campanulate tube 2.8–3.8 mm. long, 2.1–2.6 mm. in diameter, the triangular-subulate teeth commonly spreading, 1–1.7 mm. long, the whole becoming papery-membranous, ruptured, marcescent; *petals* reddish-lilac, the banner with a pale, striate lozenge in the fold; *banner* recurved through $\pm 45^\circ$, ovate-cuneate or somewhat flabelliform, openly notched, 9–10 mm. long, 6.4–7.4 mm. wide; *wings* nearly as long, 8.9–9.7 mm. long, the claws 3.1–3.7 mm., the lance-oblong, obtuse or subtruncate, nearly straight blades 5.2–6.4 mm. long, 2–2.3 mm. wide; *keel* nearly as long or a trifle longer than the wings, 8.5–9.3 mm. long, the

claws 3.5–3.8 mm., the broadly lunate or half-obovate blades 5.5–6 mm. long, 2.5–3 mm. wide, abruptly incurved through 90–95° to the bluntly deltoid apex; *anthers* 0.45–0.55 mm. long; *pod* deflexed, deciduous from a minute boss on the receptacle, very obliquely ellipsoid or lance-ellipsoid, (1.6) 2–3 cm. long, (4.5) 5–8 mm. in diameter, nearly straight in the lower third, thereafter abruptly (and so hamately) incurved through 180°, or more gently but further incurved into a nearly complete ring, cuneate at base, acuminate distally into the laterally compressed, rigidly long-cuspidate beak, otherwise dorsiventrally compressed or subtriquetrous, the ventral suture commonly depressed at base and salient distally, the dorsal one lying in a wide and open groove extending from base to beak, the somewhat fleshy, green or faintly mottled, at length leathery, stramineous, reticulate or subrugulose valves villosulous with spreading, incumbent, or curly hairs up to 0.6–0.8 mm. long, inflexed at very base or through half the length of the dorsal suture as a very narrow but sometimes almost complete septum 0.3–0.6 mm. wide; *dehiscence* apical, through the gaping beak; *ovules* 14–19; *seeds* olivaceous or purplish-brown, rugulose-punctate, dull, 1.8–2.4 mm. long.—Collections: 5 (i); representative: *Maguire & Holmgren* 25,436, 25,495 (CAS, NY, RSA, TEX, WS); *Jack L. Reveal* 372 (NY).

Dunes and sandy flats, often with *Sarcobatus Baileyi* and *Hilaria Jamesii*, about 5550 feet, rare and local, western and northwestern Nye County (Lodi Valley and vicinity of Tonopah), Nevada; also in alluvial soil of former beach, 6800 feet, north shore of Mono Lake, Mono County, California.—Map No. 133.—May and June.

ASTRAGALUS PSEUDIODANTHUS (deceptively like *A. iodanthus*) Barneby in Leaf. West. Bot. 3: 99, Pl. opp. p. 108, fig. B. 1942.—“... plateau north of Cactus Peak, about twenty miles southeast of Tonopah, Nye County ... 3 June 1941, fl. & fr., *Ripley & Barneby* No. 3725.”—Holotypus, CAS! isotypus, RSA!

The Tonopah milk-vetch, *A. pseudiodanthus*, is probably a recent derivative of *A. iodanthus* in which a mutation involving alteration in the type of vesture has coincided with adaptation to a dune or dunelike habitat and withdrawal of the root-crown to the subterranean position so common among psammophytic astragali. I have already noted local minor variants in both varieties of *A. iodanthus*, in which the pubescence has become incumbent or curly, but the hairs in these forms are shorter, at most up to 0.7 (and not up to 1 or more) mm. long, while the plants are otherwise unlike *A. pseudiodanthus*, especially in the simpler branching. In size and relative proportion of its parts, the flower of the Tonopah milk-vetch is more nearly like that of the distantly allopatric var. *vipereus* than that of var. *iodanthus*, and moreover is substantially smaller than that of the latter as it occurs shortly northward, around the head of the Reese River. In form of the pod *A. pseudiodanthus* is essentially like *A. iodanthus*; in the same plant the fruit varies in curvature from an abrupt hook into an almost complete coil.

LXXI. Sectio MONOENSES

Low caulescent perennials, with taproot and buried (rarely superficial) root-crown; *vesture* basifixed; *stipules* dimorphic, at least those at the lower (subterranean) nodes, sometimes all, at least shortly connate, the upper ones mostly (rarely all) free; *leaves* imparipinnate with 7–15 leaflets; *racemes* loosely but very shortly, often subumbellately 3–13-flowered, the flowers spreading, small, the banner mostly 6–13 mm. long; fertile *pedicels* little thickened in age, tardily disjointing; *calyx-tube* campanulate; *petals* (whitish or lilac-tinged) regularly graduated (the wings rarely a trifle longer than the banner), the keel much the shortest, its tip strongly incurved, obtuse; *pod* spreading-ascending or declined (commonly humistrate), sessile, deciduous, half-ovoid, very obliquely ovoid, or ovoid-ellipsoid, less often subglobose, turgid or bladdery-inflated, often $\pm$ obcompressed below the beak, the papery or papery-membranous valves often but not always inflexed as

a narrow partial septum; *ovules* 4–28.—Spp. 4, xerophytes, 2 very local in the southern Sierra Nevada, California; 1 of the northern Sierra in northeastern California, adjacent Nevada, and isolated in the Cascades of southern Washington; 1 of southcentral Utah.

ASTRAGALUS sect. MONOENSES, sect. nov. affinitatis dubiae, forsan *Inflatis* propiusculi, sed stipulis imis fere semper in vaginam oppositifoliam concretis et collo radices subterraneo graviter absimiles. A *Lutosi* habitu similibus stipulis inter se concretis foliolisque paucis procul distant. Legumen turgidum vel vesicario-inflatum cum *Inflatis* congruit, nunc uniloculare nunc subuni- vel semibiloculare.—Sp. typica: *A. monoensis* Barneby.

The affinities of sect. *Monoenses* are not clear to me, although they are assumed to lie in the general direction of sect. *Inflati*. Possibly it is not a natural group. Its nucleus, as I conceive it, consists of the first two species, *A. monoensis* and *A. Ravenii*, both highly localized in the southern Sierra Nevada and alike in essential pod-structure. The fruit is here only turgid or not very greatly inflated and is incompletely divided into two chambers by a narrow septum. The third species, *A. Pulsiferae*, is an enigmatically variable species with decidedly bladdery pods more often than not unilocular but sometimes provided with a rudimentary septum; its lower stipules vary from free to connate and its root-crown from superficial to buried. The comparatively rare forms of *A. Pulsiferae* in which free stipules and superficial crown coincide are technically inseparable from the *Inflati*. Its reduced number (mostly 4–8) of ovules is a strikingly peculiar character. It is referred here because of a general likeness in aspect and details of the flower to *A. Ravenii*. The fourth species, *A. Perianus*, has a bladdery pod always unilocular (so far as known) and the growth-habit and stipules of ideal *Monoenses*. The section is thus set off from the *Inflati* by its subterranean root-crown and (disregarding some exceptions in *A. Pulsiferae*) by its connate lower stipules; from the *Lutosi* by its connate stipules, shallow calyx-tube, few leaflets, and absence of gynophore; and from *Cystiella* by the obtuse keel-tip, included style, and incomplete septum. Only one of the four species was known to Jones or Rydberg, namely *A. Pulsiferae*, which they associated with *A. pubentissimus* of sect. *Inflati*, a species with a rather similar, inflated but incurved and at the same time villous pod. These two are not much alike in other respects, however, and are certainly not closely related.

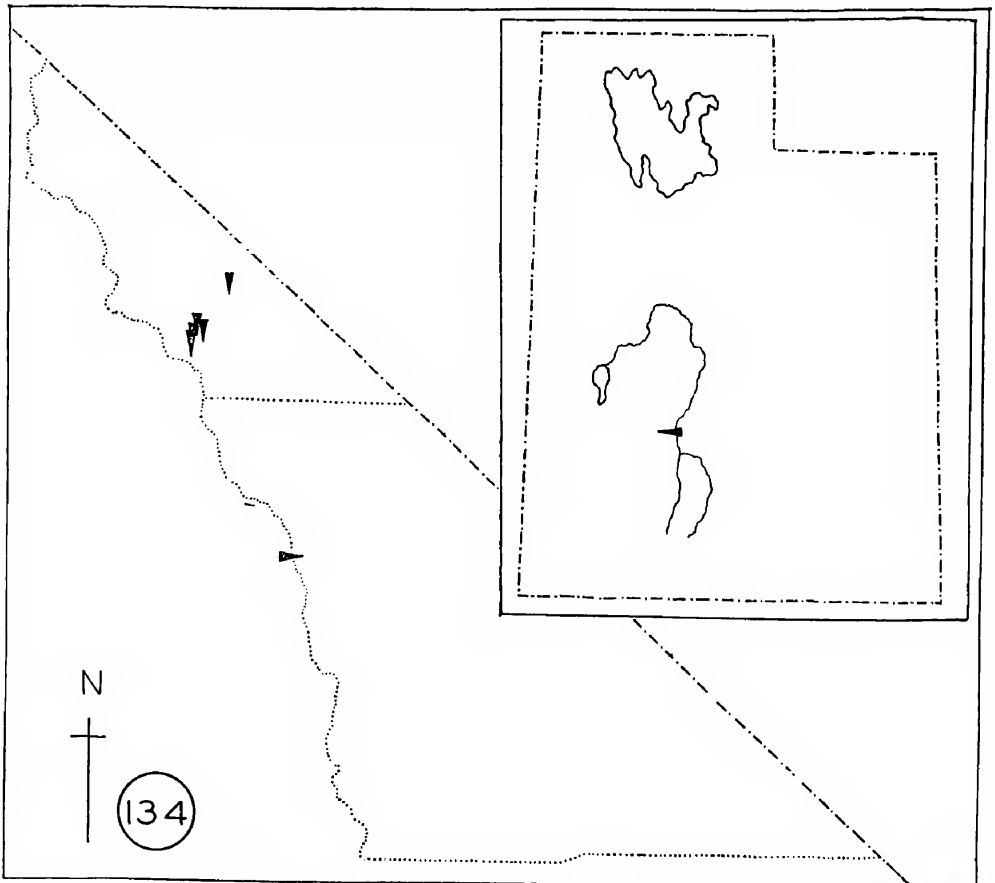
Key to the Species of Sect. *Monoenses*

1. Ovules 16–28; plants of the s. Sierra Nevada (Mono, e. Fresno, and probably Inyo Counties), California, and of s.-centr. Utah (2)
2. Pod semibi- or subunilocular, but the septum present even when narrow and obscure; California (3)
 3. Racemes 6–12-flowered; *calyx* 4.8–6.6 mm., the tube 3–4.6 mm., the teeth 1.2–2.1 mm. long; *banner* 10–13 mm., *keel* 6.7–8 mm. long; *pod* 1.5–2 cm. long, 6–9 mm. in diameter, the septum 1.2–2.2 mm. wide; e. slope of the Sierra in Mono County, about 7500–7800 ft. _____ 292. *A. monoensis*
 3. Racemes 2–6 (8)-flowered; *calyx* 3.4–4 mm., the tube 2.5–3.3 mm., the teeth 0.6–1.2 mm. long; *banner* 5.5–8.4 mm., *keel* 4.5–5.5 mm. long; *pod* 0.8–1.7 mm. long, 5–8.5 mm. in diameter, the septum 0.3–1 mm. wide; *ovules* 16–20; Sierra crest in e. Fresno County, $\pm$ 11,300 ft. _____ 293. *A. Ravenii*
2. Pod unilocular; s.-centr. Utah (Piute County) _____ 294. *A. Perianus*
1. Ovules (3) 5–9; plants of n.-e. California (Sierra, Plumas and Lassen Counties) and adjoining Nevada; also in the Washington Cascades (w. Klickitat County) _____ 295. *A. Pulsiferae*

292. ASTRAGALUS MONOENSIS

Slender, diffuse, with a taproot and subterranean root-crown or (in old plants) shortly forking, suffruticulose caudex, densely silky-villosulous nearly throughout with fine, ascending or some spreading, straight or sinuous hairs up to 0.7–0.9 (1) mm. long, the herbage silvery or sometimes greenish, the leaflets pubescent above and beneath; *stems* several or numerous, prostrate or decumbent with ascending tips, 0.7–2 dm. long, forming loosely woven mats or sometimes entangled in and weakly scrambling through low sagebrush, simple or more commonly shortly branched or spurred at 1–3 nodes preceding the first peduncle, very slender and buried for a space of 2–6 cm. at base, becoming a little stouter upward; *stipules* 1–3 mm. long, somewhat dimorphic, those at the buried nodes scarious, pallid, connate into a campanulate, subtruncate or bidentate sheath,

the median and upper ones longer, herbaceous or distally so, becoming less strongly connate upward, the uppermost united only at very base, with ovate or deltoid, mostly reflexed blades; *leaves* (0.7) 1–3 cm. long, shortly petioled or the upper ones subsessile, with 9–13 (15) usually crowded, oval, obovate-cuneate, or oblong-obovate, obtuse, loosely folded leaflets 2–8 mm. long; *peduncles* incurved-ascending, (1) 2–4.5 cm. long, equaling or commonly surpassing the leaf; *racemes* very shortly or subcapitately 6–12-flowered, the flowers subhorizontal at full anthesis, the axis little elongating, 5–12 mm. long in fruit; *bracts* herbaceous becoming papery, ovate or lanceolate, 1.5–3 mm. long; *pedicels* slender, at anthesis 0.8–1.2 mm. long, in fruit arched outward, little thickened, 1.5–2 mm. long, tardily disjointing; *bracteoles* commonly 2, sometimes minute or 0; *calyx* 4.8–6.6 mm. long, villosulous with white, sometimes mingled with a few black hairs, the subsymmetric disc 0.6–0.9 mm. deep, the submembranous, campanulate, pink-tinged tube 3–4.6 mm. long, 2.8–3.3 mm. in diameter, the broadly subulate teeth 1.2–2.1 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish $\pm$ tinged with pinkish-lavender, drying yellowish, feebly persisting about the forming pod; *banner* recurved through $\pm 50^\circ$, elliptic-oblongate or ovate-cuneate, 10–13 mm. long, 4.8–6.6 mm. wide; *wings* 9.4–10.8 mm. long, the claws 3.5–4.4 mm., the elliptic, obtuse, slightly incurved blades 6.2–7.2 mm. long, 2.2–2.9 mm. wide, the inner margin of the left one infolded; *keel* 6.7–8



Map No. 134. Inyo and Mono Counties, California, and, inset, right, Utah. Range of $\blacktriangledown$ *A. monoensis*; of $\blacklozenge$ *A. Ravenii*; and of $\blacklozenge$ *A. Perianus*.

mm. long, the claws 3.5–4.2 mm., the half-circular or -obovate blades 3.2–4.2 mm. long, 2.1–2.7 mm. wide, abruptly incurved through 100–125° to the deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* spreading or (when humistrate) ascending, sessile, obliquely ovoid-acuminate or lance-ovoid, incurved through $\pm \frac{1}{4}$ – $\frac{1}{3}$ circle, 1.5–2 cm. long, 6–9 mm. in diameter, rounded or subtruncate at base, contracted upward into a laterally compressed, triangular-acuminate, cuspidate beak, otherwise somewhat obcompressed, with shallowly and openly sulcate dorsal face, rounded lateral angles, and ventral face depressed but carinate by the prominent suture, the slightly fleshy, shortly villosulous valves becoming papery, stramineous, sometimes purple-tinged, cross-reticulate, inflexed below the unilocular beak as a partial or nearly complete septum 1.2–2.2 mm. wide; *dehiscence* apical, through the gaping beak, the walls of the septum also tardily separating; *ovules* 18–28; *seeds* dark chestnut-brown, sometimes almost black, smooth but scarcely lustrous, 2–2.6 mm. long.—Collections: 5 (i); representative: *J. T. Howell* 25,278 (CAS, ID, NY, RSA); *Ripley & Barneby* 5833 (CAS, RSA); *Reveal & Reveal* 560 (NY).

Open slopes and flats, in pumice sand or gravel, sometimes sheltering under low sagebrush, 7500–7900 feet, very local but forming colonies, east slope of the Sierra Nevada about the headwaters of Owens River (Mammoth; Crestview; Big Sand Flat), Mono County, California.—Map No. 134.—Late June to August.

ASTRAGALUS MONOENSIS (of Mono County) Barneby in Leaflet West. Bot. 4: 55, Pl. opp. p. 56, figs. 7–15. 1944.—“CALIFORNIA: . . . near Crestview, Mono Co., 10 Aug. 1938, *J. T. Howell* No. 14500.”—Holotypus, CAS! isotypi, GH, NY, RSA, US!

The Mono milk-vetch is an inconspicuous but rather pretty species of humble stature, found on open sandy flats where the plants form loosely woven mats of silvery-villous foliage up to about 3 dm. in diameter but mostly smaller. They sometimes take shelter under *Artemisia arbuscula*, where the stems become entangled in the twigs of sagebrush and often a little longer. The species is found in the same region as *A. Whitneyi* var. *Whitneyi*, in which the leaves are strigulose with appressed hairs and the pod is pendulous, balloon-shaped, unilocular, and narrowed at base into a stipe continuous with the receptacle; and it has been found nearly associated with *A. lentiginosus* var. *ineptus*, which may be distinguished by its free stipules, more numerous (mostly 15–21) leaflets, and looser racemes of comparatively many flowers with a deeper and narrower calyx-tube, these being followed by swollen but fully bilocular pods of very thin texture. The species is closely related only to the next. Its known range extends over an area not exceeding fifteen miles in diameter, but it is not uncommon locally, associated with the beautiful evening-primrose, *Oenothera xylocarpa* Cov. The Mono milk-vetch was first collected on June 26, 1925, by Frank W. Peirson.

293. *ASTRAGALUS RAVENII*

Delicate, diffuse, perennial, with a taproot and subterranean root-crown or shortly forking caudex, strigulose nearly throughout with fine, straight, appressed and a few narrowly ascending hairs up to 0.35–0.55 mm. long, the herbage silvery-cinereous, the leaflets a little more densely and loosely pubescent above than beneath; *stems* very slender, weak, prostrate, simple, 1.5–10 cm. long, pallid, glabrous and buried for a space of 1–6 cm., the few emerged internodes 2–12 mm. long; *stipules* 0.8–1.5 (2) mm. long, the lowest amplexicaul and connate into a loose, campanulate, bidentate, papery, stramineous or brownish sheath, the upper ones firm, herbaceous, sometimes purplish, less strongly connate or almost free; *leaves* 0.5–2.5 (3) cm. long, slender-petioled, with 7–11 (13) broadly oblong-obovate or suborbicular, retuse, subsessile leaflets (1) 1.5–3.5 (4) mm. long; *peduncles* filiform, (1) 1.5–5.5 cm. long, mostly far surpassing the leaf; *racemes* loosely but very shortly (2) 3–6 (8)-flowered, the flowers spreading, the axis scarcely elongating, 1.5–7 mm. long in fruit; *bracts* ovate or triangular-lanceolate, 0.7–1.5 mm. long; *pedicels* slender, straight or nearly so, ascending, at anthesis 0.5–1.1 mm., in fruit scarcely thickened and 0.8–2 mm. long, dis-jointing in age; *bracteoles* 0; *calyx* 3.4–4 mm. long, strigulose with white, or

white and a few black hairs, the slightly oblique disc 0.7–0.8 mm. deep, the submembranous, campanulate tube 2.5–3.3 mm. long, 2.2–2.5 mm. in diameter, the firm, subulate or triangular-subulate teeth 0.6–1.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish, the banner faintly lilac-veined, the keel-tip faintly maculate; *banner* abruptly recurved through 80–90°, broadly ovate-cuneate, deeply notched, (5.5) 6–8.4 mm. long, 5–6.8 mm. wide; *wings* 6–7.7 mm. long, the claws 2.1–2.4 mm., the oblanccolate or obovate, obtuse or obscurely erose-emarginate blades 4.3–6 mm. long, 1.7–3.5 mm. wide, the one (usually the right) nearly erect, the other abruptly incurved from the claw and its inner margin infolded; *keel* 4.5–5.5 mm. long, the claws 1.9–2.2 mm., the nearly half-circular blades 2.7–3.4 mm. long, 2–2.2 mm. wide, incurved through 100–120° to the blunt apex; *anthers* 0.45–0.5 mm. long; *pod* ascending (humi-strate), tardily deciduous, obliquely ovoid, gently incurved, 8–13 (17) mm. long, 5–8.5 mm. in diameter, moderately inflated but scarcely bladdery, obtuse at base, contracted distally into a short, deltoid, laterally compressed beak, otherwise obcompressed, carinate ventrally by the nearly straight to gently concave suture, low-convex dorsally, the thin, mottled, sparsely strigulose valves becoming papery, delicately reticulate, inflexed as an incomplete septum 0.3–1 mm. wide; *dehiscence* apical and downward through the ventral suture; *ovules* 16–20; *seeds* ocher-brown, sometimes purple-speckled, smooth but dull, 1.8–2 mm. long.—Collections: 3 (o); representative: *Mary DeDecker* 428 (RSA), in September, 1959 (NY).

Gravelly flats and slopes, 11,250–11,350 feet, on metamorphosed sedimentary and volcanic bedrock, near the crest of the Sierra Nevada in eastern Fresno (and probably adjoining Inyo) County, California.—Map No. 134.—July to early September.

ASTRAGALUS RAVENII (Peter Hamilton Raven, 1936–) Barneby in *Aliso* 4: 131. 1958. —“CALIFORNIA: . . . on the plateau north of Sawmill Pass, 11,250 ft., Fresno County, July 28, 1956, *Peter H. Raven* No. 9863 . . .”—Holotypus, CAS!

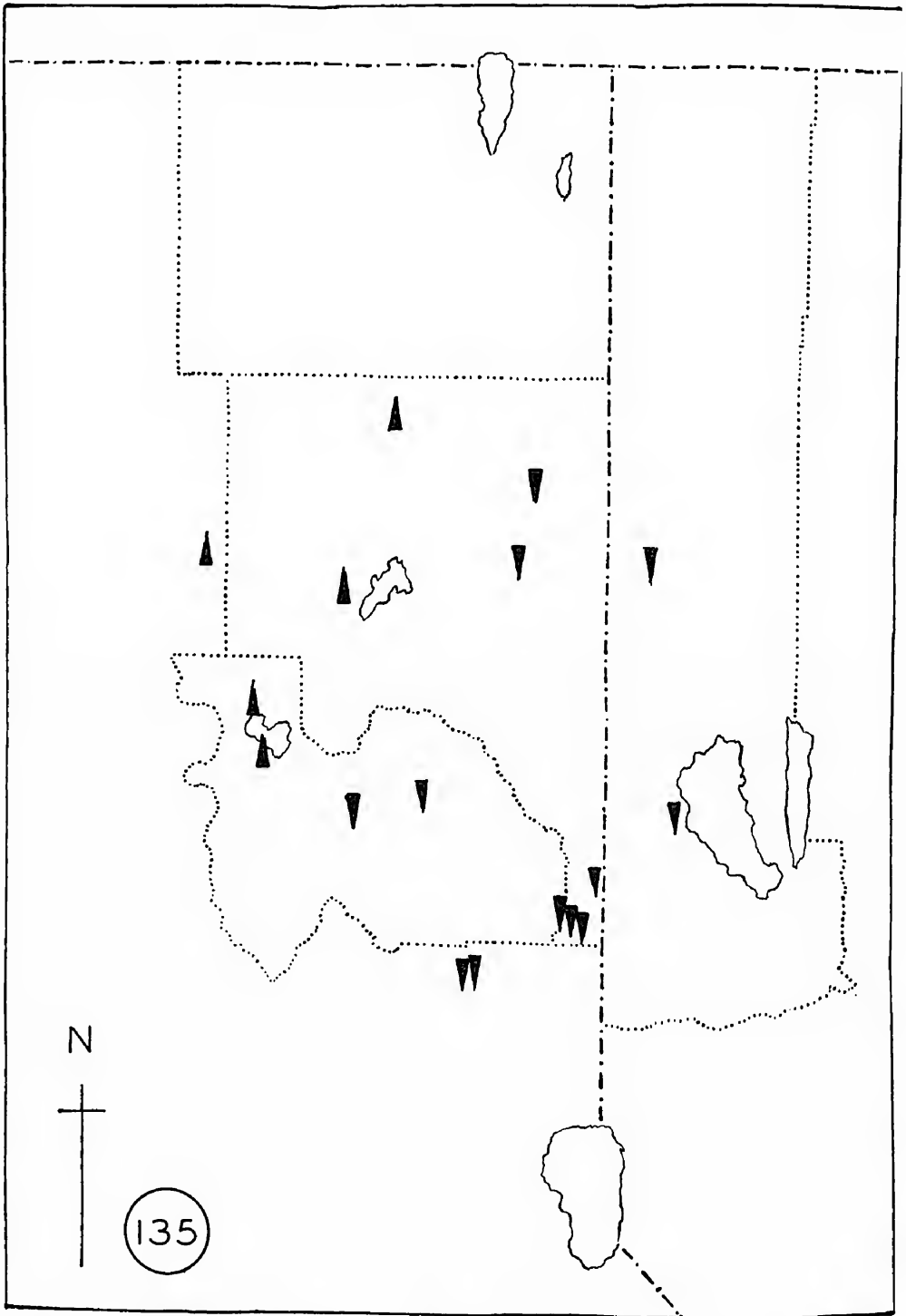
The Raven milk-vetch is delicately fashioned in every way, technically similar to *A. monoensis* but smaller and frailer, notable for its very slender stems, tiny leaflets, and small, whitish, faintly lilac-veined flowers disposed in loose clusters of two to six or rarely eight together at the end of almost threadlike peduncles. In fine detail its flower is much like that of *A. Pulsiferae*, but the vestiture of the leaves and of the ordinarily smaller, less-incurved, and less-inflated pod is thinner and appressed. Near or above tree line in the southern Sierra Nevada the only astragali at all like *A. Ravenii* in general appearance are *A. lentiginosus* var. *ineptus*, which has free stipules and larger flowers, and *A. Whitneyi* which has again larger but purple flowers and bladdery and stipitate fruit. A third species with flowers equally small but normally acaulescent is *A. platytropis*, not recorded from farther south in the Sierra than the Sweet-water Mountains in Mono County, but collected recently in the Inyo Mountains and possibly to be expected in the range of *A. Ravenii*; in this the petals are of nearly equal length and the greatly swollen pod is fully bilocular. The only known station for *A. Ravenii*, at Sawmill Pass, lies at a point on the Sierra crest about sixty miles south of the restricted area in Mono County where its closest relative, *A. monoensis*, is endemic at elevations of about 7500–7900 feet. The species is associated with the Sierra kentrophyta, *A. Kentrophyta* var. *danaus*.

294. ASTRAGALUS PULSIFERAE

Delicate, diffuse, caulescent perennial, the stems arising together from the subterranean (or sometimes superficial) crown of a woody taproot, gray-villous or -villosulous nearly throughout with fine, spreading or loosely ascending, straight or sinuous hairs up to 0.5–1.6 mm. long; *stems* few or several, decumbent or prostrate, (0.4) 1–2.5 (3) dm. long, subterranean, naked and glabrous for a space of (0) 2–8 cm., divaricately branched on emergence and the more vigorous branches again branched or spurred, floriferous upward from well below the middle, the peduncles sometimes paired with a branchlet at some distal axils;

stipules triangular or triangular-acuminate, 1–4.5 (5) mm. long, the lowest papery-scarious, the upper thinly herbaceous, all rather strongly adnate to the petiole-base and decurrent around $\frac{2}{3}$ to the whole stem's circumference, either all free, or more commonly a few of the lowest connate into a cuplike sheath; *leaves* 1–4.5 (5.5) cm. long, with slender or subfiliform, usually short petioles and (3) 7–13 commonly crowded, oblanceolate- or obovate-cuneate, retuse or more rarely truncate and apiculate, loosely folded leaflets 2–12 mm. long; *peduncles* very slender, incurved-ascending, 0.4–2.5 cm. long; *racemes* shortly but loosely (2) 3–13-flowered, the flowers declined in age, the axis not or scarcely elongating, (2) 4–12 mm. long in fruit, commonly produced as a subulate appendage beyond the last flower; *bracts* submembranous, triangular to linear-lanceolate, 0.8–2.4 mm. long; *pedicels* filiform, at anthesis 0.7–1.4 (1.6) mm., in fruit 1–1.8 mm. long; *bracteoles* 0; *calyx* 3.2–5.8 (6.2) mm. long, white-villous or -villosulous, the subsymmetric disc 0.4–0.8 mm. deep, the shallowly campanulate tube 1.3–2.6 mm. long, 1.6–2.2 mm. in diameter, the linear-lanceolate or setaceous teeth 1.4–3.6 mm. long, the whole becoming scarious, ruptured, marcescent; *petals* whitish, the banner veined, and the keel tipped with lilac (often drying yellowish); *banner* recurved abruptly through 90–100°, ovate-cuneate, notched at apex, (5.2) 6–8.5 mm. long, 4–5.6 mm. wide; *wings* (either a trifle longer or shorter than the banner) 5.4–7.2 mm. long, the claws 1.6–2.2 mm., the oblanceolate or obliquely triangular-elliptic, obtuse blades 4–5.5 mm. long, 1.5–2.3 mm. wide, both incurved but the left one more abruptly so and its inner edge infolded; *keel* 3.4–5.3 mm. long, the claws 1.5–2.2 mm., the half-circular blades 2.1–3.4 mm. long, 1.3–2.1 mm. wide, abruptly incurved through 100–130° to the bluntly triangular, obscurely porrect apex; *anthers* 0.3–0.45 (0.5) mm. long; *pod* widely spreading or declined (often humistrate), sessile on the obconic receptacle, very obliquely half-ovoid or ovoid-ellipsoid, bladdery-inflated, (0.8) 1–2 cm. long, (5) 6–11 (or when pressed seemingly up to 13) mm. in diameter, at base broadly obconic or contracted into a narrowly turbinate neck, more gradually tapering distally into a broadly triangular or triangular-acuminate, laterally compressed beak, sulcate ventrally at the middle and dorsally toward the base, the filiform ventral suture straight or concavely arched, the dorsal suture gibbous-convex, the papery-membranous, subdiaphanous, pale green or minutely purple-dotted, thinly long-villous or villosulous valves becoming stramineous and delicately reticulate, not inflexed or very narrowly so toward the pod's base as a vestigial septum less than 0.2 mm. wide; *ovules* (3) 5–9; *seeds* brown or brown speckled with purple, smooth but dull, 1.9–3.2 mm. long.

In a foreword to the section I have described the Ames milk-vetch, *A. Pulsiferae*, as enigmatically variable, alluding not alone to the differences in position of the root-crown and in connation of the lower stipules observed in otherwise similar plants, but also to a racial situation in the species set against a curious geographic background. The nomenclaturally typical phase of *A. Pulsiferae* is distinguished by its vesture of exceptionally long, horizontally spreading hairs, stems freely branching into fan-shaped sprays, a calyx with attenuately drawn-out teeth, and at least one or two pairs of stipules connate into a papery cup at the lowest subterranean nodes of the stem. It is confined to a small area along the east piedmont of the northern Sierra Nevada and plains adjoining and, so far as known to me in the field, is found in loose sandy soil or in depressions of valley dunes. Occasional populations found in the same area, at least sometimes in stiffer soils, combine the characteristic vesture and calyx with a superficial root-crown and stipules all free to the base; samples from these, judged in isolation from the whole species, cannot be excluded on technical grounds from sect. *Inflati*. I have fancied at times that *A. Pulsiferae* might be better associated with *A. (Ervoidei) microcystis*, although the presence of a septum in some forms must be weighed against a similarity (perhaps altogether fortuitous and superficial) in the growth-habit, form of the flower, and few ovules. Further complicating the picture there exists also in northern California, close to var. *Pulsiferae* but slightly to the north and west, a nearly related form, var. *Suksdorfii*, which



Map No. 135. Northeastern California and adjoining Nevada. Range of *A. Pulsiferae*:  var. *Pulsiferae*; and  var. *Suksdorfii* (the disjunct station in Washington omitted).

differs in its comparatively short pubescence of more sinuous hairs, and shorter calyx-teeth, while the simpler stems arise from a root-crown situated only rarely and at best shallowly below the level of the soil. The known range of var. *Suksdorfii* is dramatically bicentric, documented by several collections from Plumas, Lassen, and Siskiyou Counties, California, and by three, taken at the same place at intervals between 1883 and 1908, from the southern foothills of Mount Adams in the Cascade Range of Washington. This disjunct (or even if some gaps are filled in by further collecting, far-flung) dispersal suggests that var. *Suksdorfii* has a longer history than can be claimed for var. *Pulsiferae*; it seems likely that the latter is the more specialized and derived form. If the cryptophytic growth-habit can also be shown to be derived, and with it the union of the lower stipules, the affinities and systematic position of the species will need reappraisal.

Key to the Varieties of *A. Pulsiferae*

1. Stem, leaf-rachis, and peduncle loosely strigulose with ascending and subappressed hairs; *herbage* villosulous, the hairs 0.5–0.75 mm. long; *pod* villosulous, the hairs 0.4–0.55 mm. long; n.-e. California and s. Washington (Klickitat County) ————— 294a. var. *Suksdorfii*
1. Stem (at least distally), leaf-rachis, and peduncle villous with widely spreading hairs; *herbage* villous with subhorizontally divergent hairs up to 1–1.6 mm. long; *pod* villous, the hairs (0.7) 0.9–1.7 mm. long; n.-e. California and adjoining Nevada ————— 294b. var. *Pulsiferae*

294a. ASTRAGALUS PULSIFERAE var. SUKSDORFII

Root-crown commonly superficial, rarely shallowly buried; *stems* mostly simple, sometimes branching or spurred at 1–2 nodes preceding the first peduncle; *calyx-teeth* 1.4–2.1 mm. long.—Collections: 7 (o); representative: *Heller 15,179* (NY, POM); *Eggleston 7531* (NY); *Baker & Nutting* (from Pine Creek) in 1894 (ND, NY); *Suksdorf 6293* (CAS, NY, ORE, WS), 9640 (WS), topotypi.

Dry flats in open pine forest and on stony plains, in loose volcanic soils, local at about 4300 feet, in northwestern Plumas and adjoining Lassen and Shasta Counties, California; also, apparently disjunctly, in Falcon Valley near the south base of Mt. Adams, in Klickitat County, Washington.—Map No. 135.—May to July.

ASTRAGALUS PULSIFERAE var. SUKSDORFII (Howell) Barneby in *Aliso* 4: 131. 1958 ("*Suksdorfii*"), based on *A. Suksdorfii* (Wilhelm Nikolaus Suksdorf, 1850–1932, German botanist, collected extensively in s.-e. Washington and s.-w. Montana; his important herbarium at WS) Howell in *Erythraea* 1: 111. 1893.—"In loose volcanic soil near the base of Mt. Adams; collected by W. N. Suksdorf, and described by him as *A. Pulsiferae*."—Holotypus, collected in Falcon Valley, June 3, July, 1883, ORE! isotypi, *Suksdorf 481*, originally labeled: "*A. Pulsiferae* var.," GH, NY, US, WS!—*Phaca Suksdorfii* (Howell) Piper in *Contrib. U. S. Nat. Herb.* 11 (Fl. Wash.): 369. 1906.

While it is difficult in theory to distinguish all forms of var. *Suksdorfii* from all perennial *Inflati*, some few of which have small, whitish flowers and villosulous pods (but then ovules decidedly more numerous), there need be no difficulty in practice. No species at all similar is known to occur in the Washington Cascades, and the only member of sect. *Inflati* which approaches northeastern California is the fleeting annual *A. Geyeri*. In California var. *Suksdorfii* is sympatric or nearly so with the rare *A. (Chaetodontes) lentiformis* and simulates it rather closely at anthesis; but the small, compressed-triquetrous, fully bilocular pod of the latter is amply distinctive. Almost nothing is known of the ecology of var. *Suksdorfii* or of the mechanisms, edaphic or genetic, which enable it and var. *Pulsiferae* to remain distinct from one another when so nearly associated geographically.

294b. ASTRAGALUS PULSIFERAE var. PULSIFERAE

Root-crown commonly but not consistently subterranean, the stems mostly buried for a space of (0) 2–7 cm., commonly branched at emergence from the soil; *calyx-teeth* (1) 2–3.6 mm. long.—Collections: 16 (iii); representative: *Eastwood 14,865* (CAS); *Munz 11,817* (CAS, POM); *Mrs. Ames* (from Indian Valley) in 1875 (ND); *Lemmon 70* in 1875 (NY); *Ripley & Barneby 5799* (CAS, NY, RSA); *Tillotson 199* (NA).

Sandy flats and valley dunes in sagebrush valleys, or gentle slopes in stony or sandy soils of the lower transmontane foothills of the northern Sierra Nevada, mostly on basalt, 4300–5500 feet, not common but locally plentiful, eastern Plumas and adjacent Sierra and Lassen Counties, California, and closely adjoining Washoe County, Nevada.—Map No. 135.—May to August.

ASTRAGALUS PULSIFERAE (Mary E. Pulsifer Ames, 1845–1902, long resident and botanically active in Plumas County) Gray in Proc. Amer. Acad. 10: 69. 1874 ("*Pulsiferi*").—"Sierra and Plumas Counties, California, Mrs. Pulsifer-Ames and Mr. J. G. Lemmon."—Lectotypus, collected in Plumas County, August, 1874, by Mrs. Pulsifer Ames, GH! paratypus (Lemmon 515) from Long Valley, Sierra County, GH! Lemmon collections dated 1874, some numbered "53" (NY, PH, POM) are perhaps also paratypes.—*Tragacantha Pulsiferae* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca Pulsiferae* (Gray) Rydb. in N. Amer. Fl. 24: 357. 1929.

The typical form of *A. Pulsiferae* is easily distinguished from among several small-flowered astragali of its region by the extraordinarily long, widely spreading hairs which clothe the leaves and fruits. It is an inconspicuous but delicately delightful plant with marked individuality of aspect because of the diffuse fanlike branching of the rather few and very slender stems, the tiny, whitish flowers, and the greatly oblique, papery-membranous, thinly long-hirsute pods. It has somewhat the habit of *A. ammodytes* Pall. When growing in loose sand the root-crown is always buried and the lower stipules are united into a sheathing cup, but plants from stiffer soils which are composed of sand compacted with basalt pebbles, have a superficial root-crown and stipules not or at least less strongly connate (cf. Ripley & Barneby 5967, RSA).

295. *ASTRAGALUS PERIANUS*

Dwarf, very slender, with a taproot and buried root-crown, densely strigulose-villosulous with incumbent hairs up to 0.25–0.4 mm. long, the herbage ashen-canescenscent, the leaflets equally pubescent above and beneath; *stems* several, 3–7 cm. long, subterranean and leafless for a space of 1.5–4 cm., simple or minutely spurred upward, the aerial part apparently decumbent; *stipules* 1–2.5 mm. long, dimorphic, the lowest fully amplexicaul and connate into a papery, glabrous sheath, the upper ones longer, submembranous, ovate-deltoid, nearly or fully amplexicaul but free, glabrate dorsally, ciliate; *leaves* 1–3 cm. long, slender-petioled, with (7) 9–15 crowded, broadly oval- or oblong-obovate, retuse, folded, thick-textured leaflets 1.5–5 mm. long; *peduncles* subfiliform, 0.4–2.2 cm. long; *racemes* loosely but subumbellately 3–6-flowered, the flowers spreading, the axis scarcely elongating, 2–5 mm. long in fruit; *bracts* submembranous, often purplish, 0.8–1.2 mm. long, ovate; *pedicels* ascending, at anthesis very slender, 1.4–1.6 mm. long, in fruit thickened, apparently persistent, 1.5–2.5 mm. long; *bracteoles* 0; *calyx* 3.5–3.9 mm. long, pilosulous with white or mixed black and white hairs, the subsymmetric disc 0.5 mm. deep, the broadly campanulate, pink-tinged tube 2.3–2.7 mm. long, 2.3–2.5 mm. in diameter, the triangular-subulate teeth 1–1.2 mm. long, separated by wide sinuses, the whole ruptured, marcescent; *petals* yellowish when dry, perhaps whitish or roseate when fresh; *banner* abruptly recurved through 80°, broadly rhombic-ovate, retuse, 6.8–7 mm. long, 4.2–5 mm. wide; *wings* as long, the claws 2.6 mm., the narrowly oblong-oblancheolate, obtuse blades 4.8 mm. long, 1.5–1.7 mm. wide, abruptly incurved from the junction with the claw, nearly straight distally; *keel* 4.8–5 mm. long, the claws 2.5–2.7 mm., the lunately half-obovate blades 2.5–2.7 mm. long, 1.5–1.7 mm. wide, strongly incurved through 95–110° to the blunt apex; *anthers* 0.35–0.4 mm. long; *pod* spreading or ascending (humistrate), sessile on (and apparently disjoining from) the slightly elevated receptacle, broadly ovoid- or oblong-ellipsoid, bladdery-inflated, beakless or nearly so, 1.4–1.8 cm. long and (when flattened) 9–14 mm. in diameter, the thin, purple-mottled, sparsely and minutely strigulose valves becoming papery, cross-reticulate, not inflexed, the funicular flange narrow, not over 0.5 mm. wide; *dehiscence* and *seeds* unknown; *ovules* 19–20.—Collections: typus only.

Habitat not recorded, known only from the type-locality in the Sevier Valley, Piute County, Utah.—Map No. 134.—July to August.

ASTRAGALUS PERIANUS (Per Axel Rydberg, 1860–1931, here gratefully remembered for his critical appreciation of *Astragalus* in North America), sp. nov., inter *Monoenses* legumine ovoideo- vel oblongo-ellipsoideo paullo obliquo fere erostrato prorsus uniloculari necnon patria aliena insignis, ab *Inflat*is sympatricis radice collo subterraneo, stipulis imis connatis, ulterius ab *A. serpenti* Jones (cum quo specimina sua confudit Rydberg) calyce breviori, carinae laminis brevioribus, alaeque funiculari intus legumen angusta absimilis. Herba humilis striguloso-villosula, foliolis 7–15 approximatis 1.5–5 mm. tantum longis, racemis subumbellatim 3–6-floris, floribus parvulis (in sicco flavescentibus), vexillo circa 7 mm., carina obtusissima circa 5 mm. longis, legumine vesicario-inflato 1.4–1.8 cm. longo puberulo 1-loculari.—UTAH: mountains north of Bullion Creek, near Marysville, Piute County, July 23, 1905, P. A. Rydberg & E. C. Carlton 7104.—Holotypus. NY; isotypi, GH, RM.

The Rydberg milk-vetch, *A. Perianus*, is here referred to sect. *Monoenses* because of its subterranean root-crown and connate lower stipules, but the only slightly oblique, truly unilocal, almost beakless, bladderly fruit is essentially that of sect. *Inflat*i. Floristic relationships between the Wasatch and southern Sierra Nevada are few, and I question whether the similarity between *A. Perianus* and *A. monoensis* or *A. Ravenii* may not be better accounted for by parallel evolution from independent sources. The type specimens of *A. Perianus* were identified by Rydberg as *A. (Inflat)* *serpens*, another rare species endemic to the mountains of central Utah (in Wayne and perhaps Sevier Counties) which differs in its superficial caudex, free stipules, slightly shorter calyx, and shorter and differently shaped keel. The flowers of *A. serpens* are dull purple, and its pod is elevated out of the calyx on a stout, stipelike gynophore up to 1.5 mm. long; the petals of *A. Perianus*, yellowish when dry, are probably whitish or faintly roseate when fresh, and its pod is essentially sessile. Rydberg's description of *Phaca serpens* (1929, p. 349) is based in large part, though not exclusively, on his own ample collection of *A. Perianus*; I cannot doubt that it was the marked individuality of these plants which prompted him to create for *P. serpens* a monotypic sect. *Serpentes* in *Phaca*.

Nothing is known of the habitat of *A. Perianus*, but I suppose from the condition of the type-specimens, which bear flowers and fruits fully formed but not yet ripe, in conjunction with the date of the gathering, late in July, that it will be found high in the mountains, probably above 8000 feet. The appearance of the plants suggests that they grew in very loose, barren, gravelly soils, and I should expect to rediscover the species in the sort of environment favored by *Aquilegia scopulorum* Tidest. or *Draba subalpina* Macbr. & Pays.

LXXII. Sectio CYSTIELLA

Dwarf, caulescent perennials, with a buried root-crown or shortly forking caudex; *vesture* basifixed; *stipules* connate; *leaves* imparipinnate, with 7–13 leaflets; *flowers* few, subumbellate or shortly racemose, spreading, smallish, the banner 9.5–12 mm. long; *calyx-tube* campanulate; *petals* whitish or pale lilac, slightly graduated, the narrowly triangular keel-tip $\pm$ equaling the wings, a little shorter than the banner; *style* at full anthesis exerted $\pm$ 1 mm. beyond the keel, incurved below the stigma; *pod* spreading (humistrate), sessile, deciduous, broadly ellipsoid or subglobose, bladderly-inflated, fully bilocular, the valves papery; *dehiscence* primarily apical, then basal through the ventral suture, finally through both sutures and the septum, thus falling apart as two halves closed by the septum wall; *ovules* 20–28.—Sp. 1, xerophyte, very local in southwestern Utah.

ASTRAGALUS sect. CYSTIELLA Barneby in Proc. Calif. Acad. Sci. IV, 25: 166. 1944.—Sp. unica: *A. striatiflorus* Jones, emend. Barneby, op. cit. 163, Pl. 17, figs. 19–24.

296. *ASTRAGALUS STRIATIFLORUS*

Shortly caulescent, loosely tufted, densely and canescently hirsutulous throughout with spreading and ascending hairs up to 0.6–0.9 mm. long; *stems* few, arising from a buried root-crown or caudex, 1–5 cm. long, only the tips emerging from the sand, the longest distal internodes not over 1 cm. long; *stipules* 2–4

mm. long, broadly ovate or ovate-acuminate, papery-scarious or early becoming so, prominently several-nerved, fully amplexicaul and united both behind and opposite the petiole into a loose, cuplike sheath; *leaves* (1) 1.5–4 cm. long, with slender petiole and (5) 7–13 crowded or subcontiguous, ovate, obovate, or broadly oblanceolate, obtuse, mucronulate, or obscurely emarginate, loosely folded and dorsally keeled leaflets 2–7 mm. long, the petioles often subpersistent on the caudex-branches; *peduncles* slender, ascending, 1–3 cm. long, reclinate in fruit; *racemes* loosely but very shortly 2–5-flowered, the flowers spreading, the axis little elongating, 2–10 mm. long in fruit; *bracts* membranous, ovate or broadly lanceolate, 1.5–2.5 mm. long; *pedicels* at anthesis 1–1.5 mm., in fruit spreading and up to 2.5 mm. long; *bracteoles* 0; *calyx* 5.5–7 mm. long, hirsutulous with dark or mixed pale and dark hairs, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate tube 3–4 mm. long, 2.8–3.4 mm. in diameter, the subulate teeth 1.8–3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish commonly suffused with lilac, the banner purple-veined, the keel prominently purple-tipped; *banner* recurved through 45° , 9.5–12 mm. long, the short, cuneate claw abruptly expanded into a suborbicular, subentire blade 8–10 mm. wide; *wings* 8.9–11 mm. long, the claws 3.1–4 mm., the broadly oblanceolate, subtruncate blades 6.2–7.4 mm. long, 2.6–3.5 mm. wide; *keel* 9–11 mm. long, the claws 2.7–4 mm., the lunately lanceolate blades 6.2–7.6 mm. long, 2.5–3 mm. broad, gently incurved through $\pm 45^\circ$ to the narrow, acuminate, beaklike but finally obtuse apex; *anthers* 0.55–0.9 mm. long; *pod* spreading (humistrate), sessile, broadly ellipsoid or subglobose, bladdery-inflated, 1.2–1.5 (1.8) cm. long, 8–13 (or when pressed apparently up to 15) mm. in diameter, terete but shallowly and openly sulcate along both sutures, shortly apiculate-beaked, the thin, brightly mottled valves becoming papery, hirsutulous with white, shining hairs up to 0.7–1.5 mm. long, inflexed as a complete septum; *seeds* olivaceous turning dark brown, smooth, ± 2.2 mm. long.—Collections: 5 (iii); representative: *Ripley & Barneby 4358* (CAS, NY, RSA), *4365* (CAS, RSA), *4815* (CAS, K, RSA).

Ledges and mobile, dunelike detritus at the foot of sandstone cliffs, the plants commonly buried, except for the growing tips, in shifting sand, 5600–6100 feet, very local but forming colonies, known only from the south-facing Zion Escarpment, between the Virgin and Paria Rivers, Washington and Kane Counties, Utah.—Map No. 96.—May and June.

ASTRAGALUS STRIATIFLORUS (with lined, or purple-veined flowers) Jones in Proc. Calif. Acad. Sci. II, 7: 643. 1895.—“No. 6080k. September 25, 1894, above Springdale, Utah, 4000' alt., in red sand.”—Holotypus, collected by M. E. Jones, an autumnal fragment now lacking flower or fruit, POM!

The singular but delightful little escarpment milk-vetch, *A. striatiflorus*, was described by Jones from a fragmentary but fortunately still identifiable specimen by chance in flower late in September and lacking the characteristic fruit. In absence of further collections Jones lost faith in the proposition and finally (1923, Index) listed the name as a synonym of *A. Sileranus* (= *A. subcinereus*), a much taller species of the same region differing in its unilocular, emmenoloboid pod. It was unknown to Rydberg (1929, p. 455). In describing sect. *Cystiella* I have already emphasized the unique combination of morphological characters by which *A. striatiflorus* is set off from all other North American *Astragali*, and I am still doubtful of its near affinities. It is introduced at this place because it agrees most closely in the position of the root-crown, the connate stipules, and the deciduous, septiferous fruit of thin texture with sect. *Monoenses*, although still distinguished by its beaklike keel-tip and peculiar exerted style. The monotype *A. circumdatus*, which follows next in order, is perhaps more nearly related. This has many features, including a beaked keel, in common with *A. striatiflorus*, but the pod is not inflated and of fleshy, ultimately leathery texture.

A pretty little plant, *A. striatiflorus* is easily recognized by its cryptophytic growth-habit, with all but the growing tips of the stems concealed by drifting sand, by its short racemes of rather small but proportionately ample, lilac-penciled flowers, and finally by the greatly swollen,

papery, handsomely mottled and hirsutulous pod divided by a broad double septum into two chambers. In Johnson Canyon east of Kanab and near Zion Junction, the escarpment milk-vetch is confined to a narrow belt of steeply hummocked dunes lying close under the towering perpendicular cliffs, where it is associated at times with *A. ceramicus* and *A. zionis*. The known range of the species extends from Zion Canyon east to Johnson's, a crow's flight along the escarpment of some thirty or thirty-five miles.

LXXIII. Sectio CIRCUMDATI

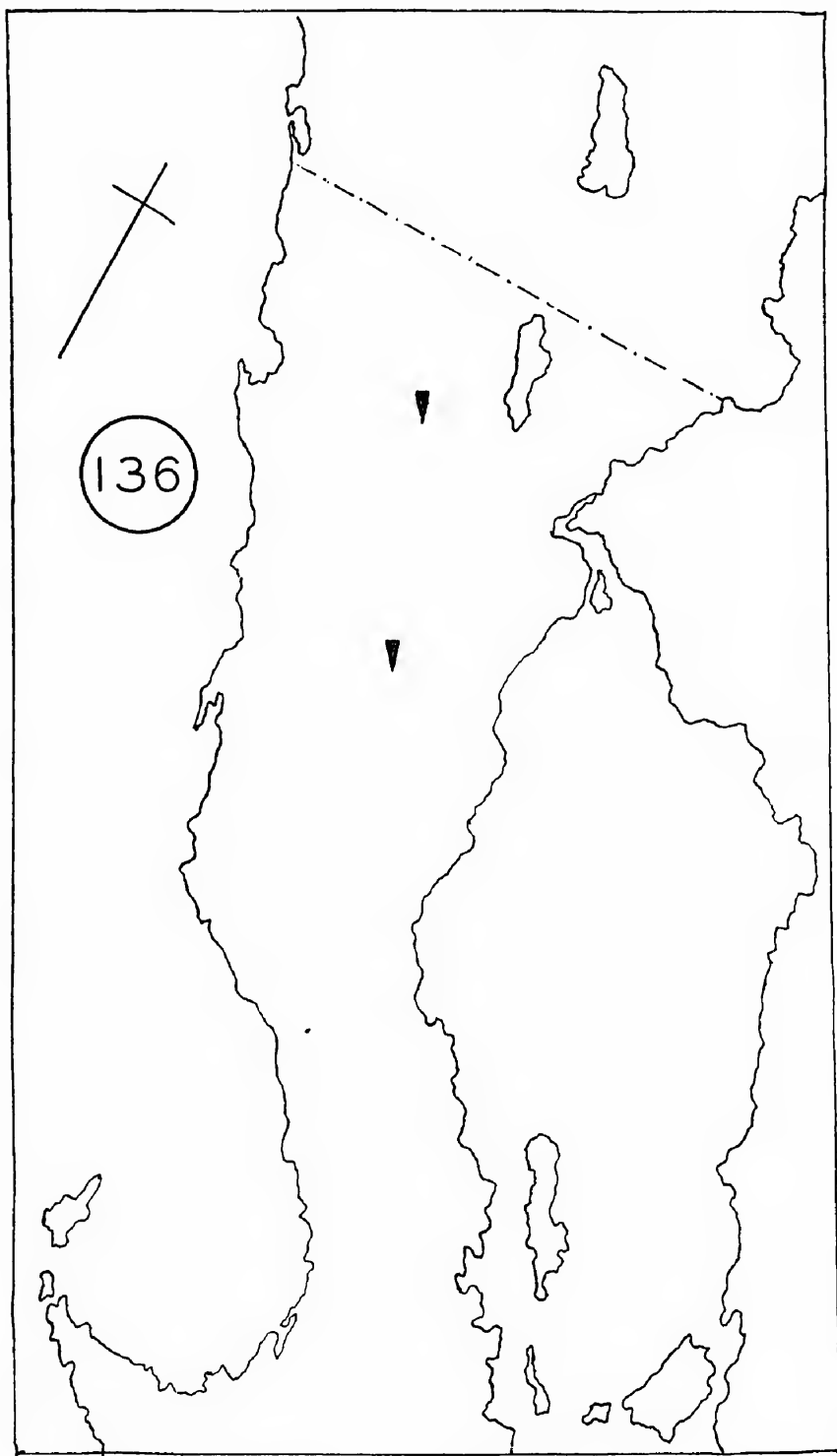
Dwarf, caulescent, perennial, with subterranean root-crown or caudex; *vestiture* basifixed; *stipules* connate; *leaves* imparipinnate, with 13–17 leaflets; *flowers* subumbellately or very shortly racemose, loosely spreading or ascending, small, the banner $\pm$ 7.5–10 mm. long; *pedicels* scarcely thickened, disjuncting in fruit; *calyx-tube* campanulate; *petals* whitish, little graduated, the banner recurved through 50–80°, the keel nearly as long as the wings, attenuate into a lance-triangular, beaklike apex; *pod* ascending, humistrate, sessile, deciduous, obovoid-ellipsoid, subterete becoming $\pm$ laterally compressed, bicarinate by the sutures, the fleshy valves becoming leathery, inflexed as an incomplete septum; *dehiscence* unknown; *ovules* 18–21.—Sp. 1, xerophyte, of the mountains of northern Baja California.

ASTRAGALUS sect. CIRCUMDATI (Jones), comb. nov., based on *Astragalus* sect. *Lotiflori* subsect. *Circumdati* Jones, Rev. Astrag. 175, in clave. 1923.—Sp. typica: *A. circumdatus* Greene.—*Brachyphragma* sect. *Circumdata* (Jones) Rydb. in N. Amer. Fl. 24: 399, in clave. 1929.

The affinities of the singular little *A. circumdatus* are far from apparent. If the pod were disregarded, the species might be referred to sect. *Monoenses*; but these have moderately to greatly swollen fruits of more or less papery texture and dorsiventral compression, and strongly graduated petals with short, blunt-tipped keel. The habit of growth coinciding with an attenuate keel-tip suggests the monotypic sect. *Cystiella*, but this also has a very different pod, thinly papery and bladdery. The species certainly has no known relative southward in Mexico, and it is logical to look to the desert mountains of southern California or to the east slope of the Sierra Nevada for clues to its relationships and systematic position. A similar pod is found in *A. (Leptocarpi) mohavensis*, but this species has a superficial root-crown and free stipules, and its flowers are quite differently shaped. It is clear that the pod of typical *A. mohavensis*, which alone resembles that of *A. circumdatus*, is recently derived from the trigonous, hamosoid type possessed by *A. mohavensis* var. *hemigyris* and the closely related *A. albens*. But no astragalus is known to exist in which a hamosoid pod coincides with the many other peculiar features of *A. circumdatus*, and a hamosoid pod is only very rarely and in special cases combined with connate stipules. The species was referred by Jones (1923, l.c.), together with *A. mohavensis*, to a subsection of sect. *Lotiflori*, but this grouping is based on carpological characters divorced from all other considerations and cannot be defended as natural. For Rydberg (1929, l.c.) *A. circumdatus* formed a monotypic section of the completely unrealistic catch-all genus *Brachyphragma*. I agree that the species is quite isolated and has no close kindred.

297. ASTRAGALUS CIRCUMDATUS

Dwarf, matted, with a taproot and loosely forking subterranean caudex, loosely strigulose with fine, straight, subappressed or narrowly ascending hairs up to 0.4–0.5 mm. long, the herbage green or greenish-cinereous, the leaflets glabrous above, pubescent along the margins and the midrib beneath; *stems* numerous, 5–12 cm. long, subterranean for a space of $\pm$ 2–4 cm., aerial and prostrately radiating for 2–8 cm., leafless at base, densely leafy upward, the internodes all short, up to 12 mm. long but mostly shorter; *stipules* membranous becoming papery, pallid or castaneous, 1–2 mm. long, the lowest connate into a loose, cuplike sheath broader than the stem and often broader than long, the upper ones fully amplexicaul, broadly ovate or ovate-acuminate, connate through half their length or only at base; *leaves* 1.5–3.5 cm. long, all petioled, with 13–17 obovate or broadly obovate-elliptic, very obtuse or emarginate, folded, thick-textured leaflets 1–5 mm. long; *peduncles* 0.5–1.5 cm. long, much shorter than the leaf, reclinate in fruit; *racemes*



Map No. 136. Northern Baja California. Range of *A. circumdatus*.

densely (3) 6–15-flowered, the flowers loosely spreading or ascending, the axis scarcely elongating, (1) 5–10 mm. long in fruit; *bracts* membranous, pallid, broadly ovate, pouched at base, 1–1.5 mm. long; *pedicels* ascending, at anthesis (0.5) 1–2.4 mm. long, in fruit sigmoidally up-curved, 1.2–2.5 mm. long; *bracteoles* 0–2; *calyx* 4.3–6.2 mm. long, strigulose-cinereous, the symmetric disc 0.8–1.2 mm. deep, the submembranous tube 2.8–3.7 mm. long, 2.3–2.8 mm. in diameter, the subulate teeth 1.5–2.5 mm. long, the whole becoming papery, marcescent about the base of the pod; *petals* whitish, immaculate; *banner* ovate-cuneate, openly notched, 7.5–10 mm. long, 5–7 mm. wide; *wings* 7–9.2 mm. long, the claws 2.9–3.8 mm., the linear-elliptic or -oblong, obtuse, very gently incurved blades 4.6–6.4 mm. long, 1.4–2 mm. wide; *keel* 7–8.8 mm. long, the claws 2.9–4 mm., the narrowly lunate-triangular blades 4.6–5.5 mm. long, 2–2.4 mm. wide, attenuate upward and incurved through 50–85° to the lance-triangular, porrect, beaklike apex; *anthers* 0.4–0.7 mm. long; *pod* ascending (humistrate), sessile, deciduous, obovoid-ellipsoid, broadest above the middle, 1–1.6 cm. long, 4–5.5 mm. in diameter, broadly cuneate at base, abruptly contracted and cuspidate at apex, subterete when fresh, becoming laterally compressed with low-convex lateral faces and prominent sutures, the green, fleshy, strigulose valves becoming leathery, brown, inflexed as an incomplete septum 1–1.5 mm. wide; *seeds* (immature) $\pm$ 2 mm. long.—Collections: 2, possibly 4 (o); representative: *Brandegee* (from Sierra San Pedro Mártir), *May 14, 1893* (POM, fragm., UC), *May 21, 1893* (NY, POM), *May 26, 1893* (DS, MO, dated '1890').

Habitat not well known, but occurring according to Brandegee in sandy places, probably in the pine belt, locally plentiful but rare, known only from Sierras Juarez and San Pedro Mártir, northern Baja California (lat. $\pm$ 31–32° N.).—Map No. 136.—May and June.

ASTRAGALUS CIRCUMDATUS (girdled, from the "narrow turgid margin" of the pressed but unripe pod) Greene, *Pittonia* 1: 173. 1888.—"Hanson's Ranch, San Rafael Mountains, Lower California, May 1888, Mr. Lemmon."—Holotypus, ND! isotypi, CAS, UC!

The girdled milk-vetch, *A. circumdatus*, is unlike any other Lower Californian astragalus and would be recognized anywhere by its dwarf stature, buried root-crown, connate stipules, attenuate keel-tip, and small, oblong-obovoid, semibilocular pod. The plants form little mats of neat, rather thick-textured leaves up to 1.5 dm. in diameter but mostly much smaller; the flowers are apparently white or whitish without any hint of a spotted keel-tip; and the pods are humistrate, lying in a ring under the leaves. No truly ripe fruits have been examined, but when green they are according to Brandegee (in Zoë 4: 204. 1892) "fleshy in the manner of *A. caryocarpus* [= *A. crassicaarpus*] and the surrounding margin appears only after drying." Actually the margins referred to by Greene and Brandegee are by no means the same. The pods collected by Lemmon were very immature, and their true structure was misunderstood by Greene, who described them as "one-celled . . . obcompressed and surrounded by a narrow turgid margin." The example of the fruit that Greene possessed chanced to fall at such an angle in the press as to become dorsiventrally flattened by pressure (as happens often in *A. missouriensis*), and the margin or girdle suggesting the specific name is simply formed by a fold of squashed-out exocarpic tissue. The genuine margin, as shown by Brandegee's specimens, is formed by sutural keels which become salient due to the inward collapse of the fleshy walls during a more natural process of ripening. In this respect the pod is quite similar to that of *A. pectinatus* and its close allies or *A. (Malaci) ensiformis*. Thus the epithet *circumdatus* remains quite appropriate, even though in reality a misnomer.

The Brandegee material of *A. circumdatus* is carelessly labeled, and I am not sure how many collections are involved. Brandegee speaks of the species as "common on San Pedro Mártir"; he may have made several collections during his stay in the Sierra in the spring of 1893.

LXXIV. Sectio PLATYTROPIDES

Perennials, either subcaulescent and tufted, or caulescent and diffuse, with either superficial or buried root-crown; *vesture* basifixed; *stipules* $\pm$ dimorphic,

the lowest commonly shortly connate, sometimes only fully amplexicaul, the upper ones narrower, free; *leaves* imparipinnate, with 7–15 leaflets; *flowers* rather few ($\pm$ 4–10), small, loosely racemose or subumbellate, spreading or declined at full anthesis, the banner 6.5–10.5 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* whitish, ochroleucous, or purplish, little or somewhat irregularly graduated, the broad, prominent keel equaling or slightly shorter than the banner, abruptly incurved distally through $\pm$ 90° and appearing truncate; *pod* spreading or ascending (humistrate), sessile, readily deciduous, ellipsoid or subglobose, greatly or moderately inflated, semi- or fully bilocular, the valves papery; *ovules* 16–34.—Spp. 3, xerophytes of eastcentral Idaho, 1 extending into western Montana, and south to northwestern Utah, southern Nevada, and eastcentral California.

ASTRAGALUS sect. PLATYTROPIDES, comb. nov., based on *Cystium* sect. *Platytopia* Rydb. in N. Amer. Fl. 24: 405. 1929.—Sp. typica: *C. platytrope* (Gray) Rydb. = *A. platytropis* Gray.—*Astragalus* sect. *Orocystium* Barneby in Proc. Calif. Acad. Sci. IV, 25: 166. 1944, a deliberate but illegitimate substitute.

The notable features common to the three *Platytrópides* are the small flowers of peculiar shape and proportions, and the sessile, distinctly swollen and usually bladderly, partly or fully bilocular pod. The little or somewhat irregularly graduated petals and especially the broad, seemingly truncate keel-tip are reminiscent of some flowers found in sect. *Diphysi*. It is difficult to find any one character justifying the exclusion of the *Platytrópides* from the latter group, unless a strong emphasis is placed on the tendency toward connation of the lower stipules. On the other hand, if each species is considered separately, I find no suggestion of close kinship to any particular member of the *Diphysi*, whereas their mutual affinity is readily apparent. There can be no doubt that the *Platytrópides* form a natural group of species, even if its status as a section is open to reevaluation. The section seems to form part of a large series characterized by small flowers and papery, deciduous fruits, coordinate with sect. *Diphysi*, sect. *Inflat*, and their satellites but of uncertain immediate origin. The union of some lower stipules into a sheath, thought to be a primitive feature in *Astragalus*, is perhaps in this case a derived character, one that has been reacquired by evolutionary reversal rather than inherited from remote times.

The distribution pattern of sect. *Platytrópides*, as shown in the accompanying map, is rather peculiar and can only be explained in terms of a long pedigree. Two species are narrowly endemic to eastcentral Idaho, where they are apparently confined to narrow ecological niches at moderate elevations of about 4600 to 6600 feet on either side of the Salmon-Lost River divide. The third species, *A. platytropis*, is widely dispersed at elevations mostly above 8500 feet on scattered mountain tops throughout a great part of Nevada (extending just into Utah and California), and then quite surprisingly it reappears in sagebrush valleys between 5600 and 7000 feet in a disjunct area in eastcentral Idaho, close to its near relatives, and adjoining southwestern Montana. It might be assumed that the common ground about the headwaters of the Salmon River was the original theatre for speciation in the *Platytrópides* and that the contemporary distribution of *A. platytropis* has been achieved by migration southward. I suspect that it would be more correct to envisage *A. platytropis* as already dispersed during some cooler and moister period (very likely coinciding with the Wisconsin glaciation) over the whole of its present range. Increasing temperatures and decreasing rainfall would tend to drive the species upward, and the farther south the farther upward, into isolated montane refugia precisely where it is found today to the south of the Snake River. It would then be supposed that the species is barely holding its own in the now disjunct north lobe of its former range; but that the two narrow endemics of central Idaho, *A. amblytropis* and *A. amnis-amissi*, arose by mutation and subsequent adaptation to newly created and highly selective habitats. The restriction of *A. amblytropis* to mobile slides in the recently sculptured canyon of the Salmon River, where it is associated with several endemic species of southern affinity, is especially suggestive of recent origin.

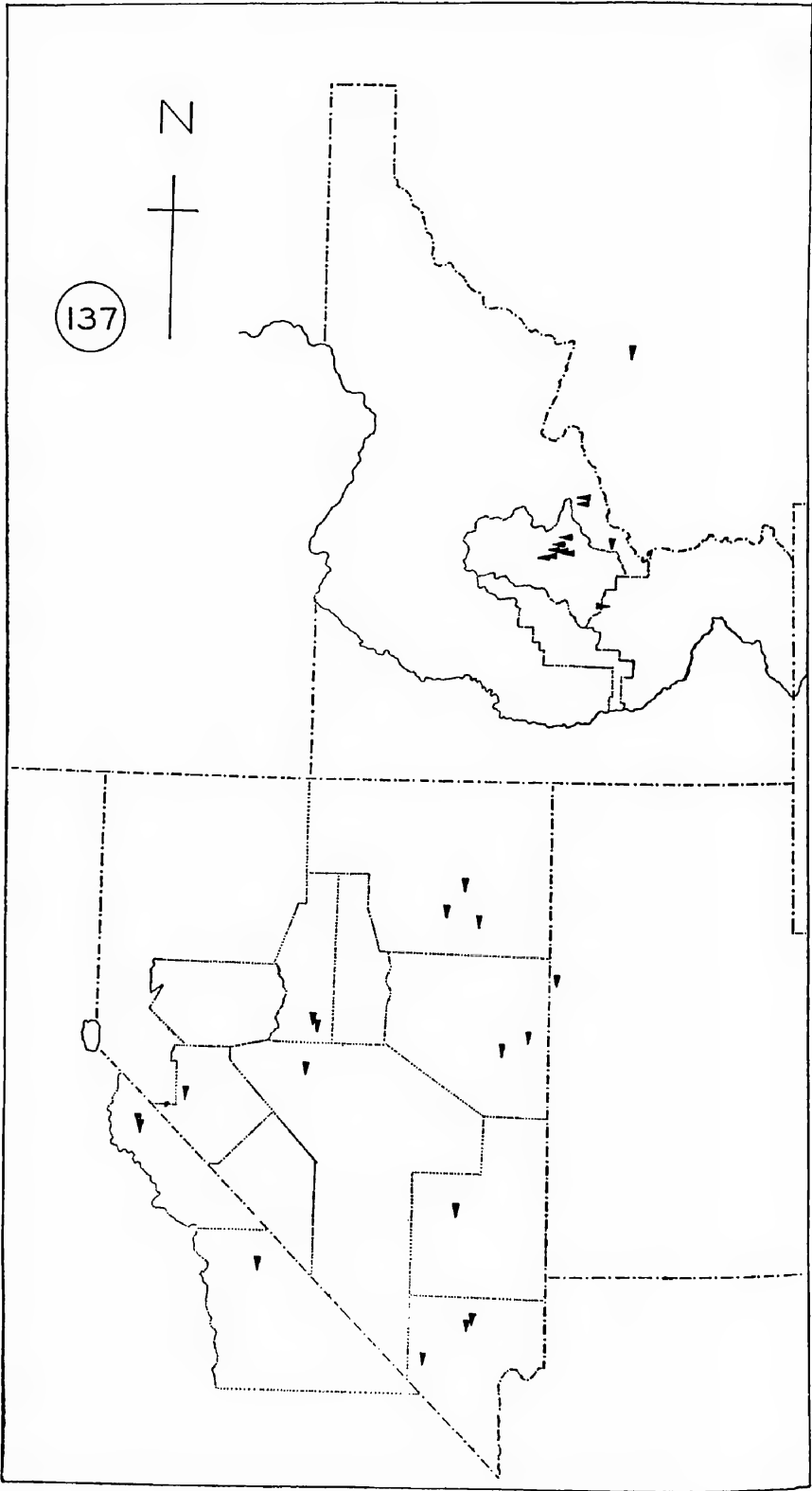
Key to the Species of Sect. *Platytrópides*

1. Caespitose, acaulescent or nearly so, the stems mostly reduced to crowns (the caudex sometimes elongating on mobile rock slides near timber line), the year's growth at most 2 cm. long, the peduncles subscapose; *racemes* subcapitate, the axis less than 1 cm. long in fruit; *pod* bladderly-inflated, fully bilocular, the partition formed by a true septum and a funicular flange of $\pm$ equal width united by their edges near the middle of the pod-cavity; range of the section 298. *A. platytropis*

1. Diffuse or weakly ascending, strongly caulescent, the internodes all developed, the stems 1-4 dm. long, the peduncles axillary; *racemes* looser, the axis 5-30 mm. long in fruit; *pod* various, but if both greatly inflated and fully bilocular then the septum proper produced across the width of the cavity and the funicular flange very much narrower; local in e.-centr. Idaho (2)
2. Herbage green, sparsely strigulose, the leaflets subglabrous above; *stems* arising from the root-crown or shortly forking caudex at soil-level, simple, 1-2.5 dm. long; *peduncles* mostly 3-8 cm. long; *pod* comparatively small, only moderately inflated, $\pm$ 1.5-1.7 cm. long, less than 1 cm. in diameter, semibilocular, the septum $\pm$ 1.5 mm. wide; *ovules* 16-20; Lost River Mountains, Custer County 299. *A. amnis-amissi*
2. Herbage densely strigulose, the growing tips canescent, the leaflets equally pubescent on both sides; *stems* arising from a buried root-crown, freely branched on emergence and upward, 1-4 dm. long; *peduncles* $\pm$ 0.5-2 cm. long; *pod* large, bladderly-inflated, 2-3.5 cm. long, over 1 cm. in diameter, fully bilocular, the septum 3-7 mm. wide; *ovules* 25-32; Salmon River canyon in Custer and Lemhi Counties 300. *A. amblytropis*

298. ASTRAGALUS PLATYTROPIS

Dwarf or diminutive, closely tufted, acaulescent or nearly so, with a taproot and pluricapital crown, this forking in old plants into a suffruticulose caudex commonly beset with a thatch of persistent petioles and stipules (on shifting rock slides the caudex sometimes buried and elongating, rarely up to 1.6 dm. long), strigulose throughout with fine, straight, appressed hairs up to 0.35-0.6 mm. long, the herbage silvery- or gray-silky, the inflorescence commonly black-hairy; *stems* of the year mostly reduced to crowns, exceptionally up to 2 cm. long but the internodes even then seldom surpassing the stipules, exceptionally 1 or 2 of them up to 1 cm. long; *stipules* subherbaceous becoming papery and brownish, 1.5-5.5 mm. long, mostly several-nerved, the lowest amplexicaul and usually shortly connate, the rest semiamplexicaul, with ovate or lance-acuminate, erect or spreading blades; *leaves* (1) 1.5-9 cm. long, with slender, wiry petioles and (5) 7-15 moderately distant or crowded, elliptic, obovate, oblong-obovate, or oval, acute, obtuse, or rarely retuse, flat or loosely folded leaflets (2) 4-11 mm. long; *peduncles* slender or subfiliform, 1.5-6.5 (8) cm. long, ascending at anthesis, arcuate-decumbent or prostrate in fruit; *racemes* subumbellately (2) 4-9-flowered, the axis scarcely elongating, 2-6 mm. long in fruit; *bracts* membranous, pallid or brownish, ovate or lance-acuminate, 0.6-2 mm. long; *pedicels* straight, ascending, at anthesis 0.7-1.4 mm., in fruit a trifle thickened, 1-1.9 mm. long; *bracteoles* 0-2, minute when present; *calyx* (3) 3.3-4.6 mm. long, densely strigulose with black or mixed black and white, rarely all white hairs, the symmetric disc 0.5-0.8 mm. deep, the tube 2-2.7 mm. long, 1.7-2.2 mm. in diameter, the subulate, linear-subulate, or triangular, acute or obtuse teeth (0.6) 1-2 mm. long; *petals* whitish or sordidly suffused with lilac or dull lavender or leaden-purple; *banner* gently recurved through 30-45°, oblong-ovate beyond the short, cuneate claw, shallowly notched or entire, 7.2-9.5 mm. long, 4.4-5.2 mm. wide; *wings* (nearly as long to 1 mm. longer than the banner) 7.6-9.4 mm. long, the claws 2.5-3.1 mm., the obliquely oblong, obtuse or submarginate, straight or slightly incurved blades 5.4-7.4 mm. long, 2.1-2.7 mm. wide; *keel* nearly as long or slightly longer than the banner, 7.8-8.6 mm. long, the claws 2.6-3.3 mm., the broadly oblong-oblongate blades 5.7-6.5 mm. long, 2.4-3 mm. wide, abruptly incurved through about 90° to the obtusely deltoid or broadly rounded apex, appearing truncate in profile; *anthers* 0.45-0.55 mm. long; *pod* loosely ascending (humistrate), broadly ovoid, ovoid-ellipsoid, or subglobose, bladderly-inflated, 1.5-3.3 cm. long, 1-1.8 (or when flattened apparently to 2.2) cm. in diameter, obtuse at base, contracted at apex into a very short, conical, or laterally compressed and deltoid beak, the body slightly



obcompressed, shallowly sulcate along the ventral or both sutures, the thin, purple-speckled or -mottled, strigulose valves becoming papery, brownish, finely cross-reticulate, inflexed as a septum 1.8–3 mm. wide produced $\pm$ half way across the cavity to unite with a funicular flange 2–4.5 mm. wide; *dehiscence* apical, after falling; *ovules* 26–34; *seeds* brown or orange-brown, smooth or minutely pitted, 1.8–3.2 mm. long.—Collections: 28 (ii); representative: *Tweedy* (from Beaverhead County) *undated* (F, GH, NY); *Alexander & Kellogg 4546* (UC); *J. & M. Linsdale 321, 505* (CAS, RSA); *Clokey 5618* (CAS, GH, NA, NY, RSA, SMU, UC, WS); *Ripley & Barneby 4028* (CAS, RSA); *Roos & Roos 5961* (NY, RSA).

Dry rocky crests, gravelly ridges and scree, descending from near timber line to openings in the forest belt, commonly on limestone but occasionally on granite or in pumice-sand, mostly 8600–11,750 feet, local, western Utah (Deep Creek Mountains, Tooele County) southwest through the higher mountains of Nevada (West Humboldt, Ruby and Spruce Mountains, Elko County; Egan and Schell Creek Ranges, White Pine County; Toiyabe Mountains, northern Nye and southern Lander Counties; Mt. Irish (at “6200 ft.”), Lincoln County; Wassuk Range, Mineral County; and Sheep and Charleston Ranges, Clark County) to eastcentral California (Sweetwater and White Ranges, Mono County; Inyo Mountains, Inyo County); also rarely in dry sandy or rocky soil of sagebrush hillsides, 5550–7000 feet, probably on limestone, on the upper Pahsimeroi River in eastcentral Idaho and in adjoining Beaverhead County, Montana.—Map No. 137.—July to August southward, fruiting in June in the northern lowland stations.

ASTRAGALUS PLATYTROPIS (with broad keel) Gray in Proc. Amer. Acad. 6: 526. 1865.—“With the preceding species,” i.e., *A. ineptus* and *A. Whitneyi*, these found on a “dry rocky mountain near Sonora Pass, [California], in loose gravel and sand near the summit (alt. 10,000 ft.).”—“Holotypus, collected by W. H. Brewer in 1863, GH! isotypi, K, US!—*Tragacantha platytropis* (Gray) O. Kze., Rev. Gen. 947. 1891. *Phaca platytropis* (Gray) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 246. 1900. *Cystium platytrope* (Gray) Rydb. in Bull. Torr. Club 40: 50. 1913 (“*platytropis*”).

The broad-keeled milk-vetch, *A. platytropis*, is a strongly marked astragalus, easily recognized by its tufted, silvery-gray foliage, subcapitate racemes of small, luridly purplish flowers with petals of nearly equal length, and disproportionately large and swollen, red-speckled or mottled pod. The partition within the fruit is composed in about equal parts of genuine septum, arising as an invagination of the endocarp from the dorsal suture, and of a flange formed by a web of tissue connecting the exceptionally long seed-funicles. As a consequence of the unusual development of the flange, the seeds are disposed in two rows lengthwise along the middle of the pod's cavity, not approximate to the ventral suture as happens in the ordinary inflated legume.

The contemporary populations of *A. platytropis* are spatially isolated to a degree that must prevent any exchange of pollen between them, and it is not surprising to find that somewhat different modes of variation have become established in different parts of the discontinuous range. In some stations the leaflets are all elliptic and acute, in others (especially southward) all obovate and obtuse. In stable habitats the plants are truly caespitose and stemless, but on mobile scree or talus the caudex-branches elongate as they become buried by shifting gravel. The calyx-teeth are most commonly subulate or linear-subulate, but occasionally become shortened and obtusely triangular. Otherwise neither flower nor fruit shows much variation, and the fundamental features of the species must have become fixed at a comparatively early date.

The type-locality of *A. platytropis*, *A. ineptus*, and *A. Whitneyi*, vaguely indicated as a mountain near Sonora Pass, was probably not in the Sierra proper but more likely in the Sweetwater Mountains, the rugged profile of which can be viewed from the Sierra crest at Sonora Pass across the trench of the upper Walker River Valley. All three species are known to occur in the Sweetwaters, but *A. platytropis*, essentially a Basin species, has not been collected in the Sierra in modern times.

299. *ASTRAGALUS AMNIS-AMISSI*

Slender, caulescent, with a taproot and shortly forking aerial caudex, strigulose with fine, straight, appressed or subappressed hairs up to 0.3–0.4 mm. long, the herbage green, the leaflets thinly pubescent to nearly glabrous above (exceptionally, in some upper leaves, more densely pubescent above than beneath); *stems* few ($\pm$ 2–7), weakly ascending, 1–2.5 dm. long, simple or feebly spurred at base, floriferous from $\pm$ 3–6 nodes upward from near or commonly from well below the middle; *stipules* 1.5–5 mm. long, the small, triangular-ovate lower ones papery-membranous, pallid or brownish, the larger median and upper ones ovate or broadly lanceolate, herbaceous, mostly reflexed, all strongly, often fully amplexicaul, but free or only very obscurely connate; *leaves* (3) 4–9.5 cm. long, slender-petioled, with (7) 9–13 broadly ovate-oblong or oblong-elliptic, retuse or emarginate (in some lower leaves small and obcordate) flat, thin-textured, faintly penninerved leaflets (3) 4–15 (18) mm. long; *peduncles* slender, at anthesis incurved-ascending, divaricate or recurved in fruit, (2) 3–6 (8) cm. long, shorter than the leaf; *racemes* loosely but shortly 5–12-flowered, the flowers at first ascending, spreading or loosely declined in age, the axis somewhat elongating, 1–3 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–2 mm. long; *pedicels* at anthesis slender, ascending, 1–1.7 mm. long, in fruit either ascending or arcuately recurved, scarcely thickened, 1.7–2.2 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4–5.9 mm. long, strigulose with black or mixed black and white hairs, the subsymmetric disc 0.4–1 mm. deep, the submembranous, green or purplish, campanulate tube 2–3 mm. long, 1.9–2.1 mm. in diameter, the subulate or lance-subulate teeth 1.8–2.9 mm. long; *petals* whitish distally suffused with purplish-blue, the banner sometimes purple-striate, the keel-tip prominently maculate; *banner* recurved through $\pm$ 40°, broadly ovate-cuneate, rather deeply notched, 8.8–10.4 mm. long, 5.6–8 mm. wide; *wings* (0.6 mm. shorter to 0.5 mm. longer than the banner) 8.6–10.5 mm. long, the claws 2.4–3.1 mm., the oblong-oblancheolate, obtuse or emarginate, straight blades 7–8.4 mm. long, 2.2–3.1 mm. wide; *keel* (0.5–1.1 mm. shorter than the banner) 7.8–9.8 mm. long, the claws 3–3.8 mm., the broadly half-oblong-obovate blades 5.3–6.6 mm. long, 2.5–3.1 mm. wide, abruptly incurved through 90° to the bluntly deltoid apex, truncate in profile; *anthers* (0.4) 0.5–0.6 mm. long; *pod* ascending or loosely spreading (humistrate), sessile, subsymmetrically ellipsoid or ovoid-ellipsoid, moderately inflated but not strongly bladdery, $\pm$ 1.5–1.7 cm. long, 7–8 mm. in diameter, a little obcompressed, shallowly and openly sulcate ventrally, the thin, green or purplish, strigulose valves becoming papery, stramineous, finely cross-reticulate, inflexed as a partial septum $\pm$ 1.6 mm. wide, the funicular flange narrow, $\pm$ 0.5 mm. wide; *ovules* 16–20; *dehiscence* and *seeds* unknown.—Collections: 2 (i); representative: Ripley & Barneby 8799 (CAS, RSA).

Rock crevices and talus under limestone cliffs, 6300–6600 feet, known only from the canyon of Pass Creek, in the Lost River Mountains, southeastern Custer County, Idaho.—Map No. 137.—Late June to August.

ASTRAGALUS AMNIS-AMISSI (of Big Lost River, of which Pass Creek is the chief northern tributary) Barneby ap. Hitchc. & al. in Univ. Wash. Pub. Biol. 17: 219. 1961.—“Hitchcock & Muhlick 21331, along base of cliffs and in rock crevices, Pass Creek Gorge, 10 miles n. of Leslie, Custer Co., Ida., July 2, 1957 . . .”—Holotypus, WTU! isotypi, CAS, NY, RSA, US!

The Lost River milk-vetch, *A. amnis-amissi*, is closely related to *A. amblytropis*, but the essentially simple stems arising from a superficial root-crown and caudex, the slightly larger flowers, and especially the smaller, semibilocular, relatively few-ovulate pod provide amply satisfactory specific differences. The leaves are of thinner texture than in *A. amblytropis* and much more thinly strigulose; but in one plant of the type-series, the leaflets of some upper

leaves are more densely pubescent above than beneath and cinereous when young, so a greater variation in this direction must be anticipated as the species becomes better known. Furthermore, a caulescent astragalus similar to *A. amnis-amissi*, except for the apparently buried root-crown and the silvery-glaucous foliage, has been collected in young flower on a "moist hillside by aspens" at the Forks of the Wood River, Blaine County, Idaho (George Wood in 1941, IDS). The specimens, which are insufficient for analysis, have not been compared directly with the *typus* of *A. amnis-amissi*, but suggest a form of the latter or a close relative as yet undescribed.

In a very general and superficial way the Lost River milk-vetch resembles *A. alpinus*, for the whitish flowers distally suffused with purplish-blue, the prominent maculate keel, and the broad leaflets of thin texture invite comparison with that common astragalus of the western Cordillera. However, the sessile deciduous pod and the determinate root-crown of *A. amnis-amissi* are fundamentally different.

300. ASTRAGALUS AMBLYTROPIS

Slender, caulescent, diffuse or trailing, with vertical or obliquely penetrating tap-root and buried rootcrown, densely strigulose with appressed, filiform or somewhat flattened and scalelike hairs up to 0.25–0.35 mm. long, the herbage cinereous or silvery-canescens, the leaflets somewhat bicolored, the upper surface almost as densely pubescent as the lower but of a yellowish-green cast beneath the vesture; *stems* few or solitary, prostrate or nearly so, 1–4 dm. long, naked and subterranean for a space of 2–10 cm., thereafter divaricately branched from the first to the fifth emerged node, the more vigorous branches again branched or spurred, the branchlets (and, upward, the peduncles) sometimes paired with a spur, the whole forming a flat, fan-shaped spray; *stipules* 1–2.5 mm. long, the subterranean ones early decaying or broken and their structure obscure, those at the early aerial nodes amplexicaul and connate into a low, scarious, brownish, usually several-nerved collar, the rest herbaceous, often purplish, $\pm$ semiamplexicaul, ovate or deltoid-acuminate, with spreading or deflexed blades; *leaves* mostly divaricate or deflexed, 1–3 (4.5) cm. long, shortly petioled or the uppermost sessile, with 9–13 commonly crowded, obovate, cuneate-obovate, or oblanceolate, obtuse or retuse (and then sometimes obcordate), flat or loosely folded leaflets 3–9 (14) mm. long; *peduncles* spreading or incurved, (3) 5–22 mm. long, commonly shorter than the leaf; *racemes* loosely but shortly, sometimes subumbellately (4) 6–10 (13)-flowered, the flowers sub-horizontal at full anthesis, declined thereafter, the axis 0.5–1.5 (2) cm. long in fruit; *bracts* scarious, ovate or lanceolate, 0.6–1.5 mm. long; *pedicels* at anthesis spreading-ascending, slender or filiform, 1–2 mm. long, in fruit variably spreading or recurved, somewhat thickened, 1.8–2.5 mm. long; *bracteoles* 0; *calyx* (2.8) 4.1–5 mm. long, densely white-strigulose, the symmetric disc 0.4–0.7 mm. deep, the tube 1.9–2.7 mm. long, 1.9–2.1 mm. in diameter, the linear-subulate to shortly subulate teeth (0.9) 1.5–2.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* dull straw-yellow often $\pm$ suffused with lilac, the banner often lilac-veined, the keel-tip maculate; *banner* recurved through 40–50°, ovate-cuneate or somewhat flabelliform, 6.4–8.3 mm. long, 5–6.6 mm. wide; *wings* slightly longer, 6.8–9 mm. long, the claws 2–3.1 mm., the oblong, obtuse or shallowly emarginate, nearly straight blades 5.6–6.8 mm. long, 2–2.4 mm. wide; *keel* nearly as long or a trifle longer than the banner, 6.8–8.3 mm. long, the claws 2.2–3.3 mm., the obliquely blunt-triangular blades 5–5.7 mm. long, 2.5–3.1 mm. wide, rather abruptly incurved through 50–95° to the very obtuse apex; *anthers* 0.45–0.55 mm. long; *pod* spreading or ascending (humistrate), ovoid or ellipsoid, bladdery-inflated, 2–3.5 cm. long, 1.2–2 (or when pressed seemingly up to 2.6) cm. in diameter, rounded at base, contracted distally into a short, deltoid or triangular, erect or slightly incurved, laterally flattened or subconical beak, otherwise a little obcompressed, shallowly sulcate along both sutures, the thin, pale green but purple-

cheeked, densely to thinly strigulose valves becoming papery, stramineous, sub-transparent, delicately cross-reticulate, inflexed across the width of the cavity (below the beak) as a complete septum 3–7 mm. wide; *dehiscence* apical, basal, and ultimately through the ventral suture; *ovules* 25–32; *seeds* pale ocher or olive-brown, sometimes minutely purple-speckled, smooth but dull, (2.6) 3–3.7 mm. long.—Collections: 9 (iv); representative: *Macbride & Payson* 3340 (DS, NY, RM); *Ripley & Barneby* 8825 (CAS, NY, IDS, RM, RSA, UTC, WTU) 8830 (CAS, RSA), 8844 (RSA); *C. L. Hitchcock* 15,683 (RSA).

Steep slopes of soft clay, mobile shale and clay detritus, or volcanic gravel slides, 4600–5600 feet, locally plentiful along the canyon of the Salmon River and its tributary creeks for a distance of $\pm$ 30 miles up- and downstream from Challis, in Custer and Lemhi Counties, Idaho.—Map No. 137.—Late May to early July.

ASTRAGALUS AMBLYTROPIS (with blunt keel) Barneby in Amer. Midl. Nat. 41: 502. 1949. —“... ten miles west of Clayton, Custer Co., Idaho, 28 June 1946, fl. & fr., *Hitchcock & Muhlick* No. 14115.”—Holotypus, WTU! isotypi, MO, NY, RSA, WS!

The Challis milk-vetch, *A. amblytropis*, is a delicately delightful little astragalus of marked and singular individuality, recognizable at a glance by its repeatedly and divaricately branching stems, neat, silvery foliage, small flowers with petals of nearly equal length, and bladdery, bilocular pods. The plants fruit prolifically, and the subdiaphanous bladders, at first pale green suffused with purple on the side turned toward the sun, then straw-colored and somewhat lustrous when ripe, are enormous in proportion to the leaves and flowers. The partition within the pod, unlike that of *A. platytropis* described above, is formed almost wholly by the genuine septum, the funicular flange remaining quite narrow and the seed-funcles not greatly elongated. The Challis milk-vetch is remarkable in its section for the subterranean root-crown, which has no doubt developed in adaptation to the almost obligate habitat on steep gullied clay slopes and banks of mobile shale and gravel. However, occasional stray seedlings from the slopes above, which become established on sand bars on the canyon floor, retain the cryptophytic habit of growth, which must be an inherent and inherited character of the species.

LXXV. Sectio VILLOSI

Diffuse, caulescent, of moderate or low stature, perennial but often of short duration, sometimes flowering the first season; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with (3) 7–27 leaflets; *flowers* racemose, declined in age, of small or moderate size, the banner $\pm$ 8–17 mm. long; *pedicels* persistent or very tardily disjoining; *calyx-tube* campanulate; petals greenish-white, cream-color, or purple with pale wing-tips, regularly graduated, the keel-tip obtuse; *pod* naturally ascending (humistrate) but variably oriented in some dried specimens, sessile on and deciduous from the receptacle or incipient gynophore, crescentic, lunately half-elliptic, or half-obovate in profile, variably compressed, sulcate along one, neither, or both sutures, the stiffly papery or leathery valves not inflexed or inflexed as a rudimentary septum; *ovules* 12–37.

The sect. *Villosi* consists of two subsections, the typical composed of *A. villosus* only, a species much further distant from subsect. *Austro-orientales* than the members of the latter are one from another; it is distinguished from the glabrescent, purple- or white-flowered *Austro-orientales* by its extremely long, hirsute vesture, yellowish petals, pronounced triquetrous compression of the pod, and few leaflets of submembranous texture. The subsections and the affinity between them were already perceived nearly in their present form by Gray (1864, p. 207–8), although it is preferable to remove *A. villosus* from sect. *Lotiflori*, of which the typus is characterized by dolabriform hair-attachment. The species of sect. *Villosi* as now delimited were dispersed by Jones among his sects. *Sparsiflori* and *Hamosi*, the very closely related pair of species, *A. distortus* and *A. obcordatus*, being unnaturally separated in the Revision by over 120 pages of text. They were reassembled by Rydberg into an otherwise heterogeneous *Batidophaca* sect. *Villosae*, from which, however, is derived the presently accepted name for the more narrowly defined section.

The relationships of the *Villosi* lie presumably in the direction of the *Inflati* on the one hand and the hamosoid sections on the other. They are very close to the *Inflati* in all respects, but the pod, almost or fully unilocular though it be, is of thicker texture and tends to be sulcate dorsally and then incipiently or actually trigonous. The section is isolated geographically from the principal centers of speciation in the genus and has probably enjoyed a long period of independent evolution.

Key to the Subsections of Sect. *Villosi*

1. Herbage thinly strigulose with short, subappressed hairs not over 0.7 mm. long, or subglabrous; *ovary* and pod glabrous; *leaflets* 13–27, of firm texture, the nervation invisible; *petals* commonly pink-purple, lavender, or white with lavender keel-tip, exceptionally ochroleucous LXXV (i). Subsect. *Austro-orientales*
1. Herbage hirsute with widely spreading, often spirally twisted hairs up to 1.1–2 mm. long; *ovary* and pod hirsute; *leaflets* 3–15, of thin texture, the larger ones visibly penninerved; *petals* yellowish LXXV (ii). Subsect. *Villosi*

LXXV (i) Subsectio AUSTRO-ORIENTALES

Characters as given in the subsectional key.—Spp. 3, xerophytes, of south-eastern and eastcentral United States (Illinois to eastern Texas, Maryland, and Florida).

ASTRAGALUS sect. VILLOSI subsect. AUSTRO-ORIENTALES (Gray), comb. nov., based on *Astragalus* sect. *Oroboidei* subsect. *Austro-orientales* Gray in Proc. Amer. Acad. 6: 207. 1864 ("*Austro-Orientales*").—Sp. lectotypica: *A. distortus* T. & G.

Holcophacos Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903.—Generitypus: *H. distortus* (T. & G.) Rydb. = *A. distortus* T. & G.

Key to the Species of Subsect. *Austro-orientales*

1. Pod not very prominently reticulate when ripe; *flowers* variable in size, but if the banner only 11 mm. long or less, then the calyx-teeth only 0.8–1.8 mm. long; *ovules* 16–37, but always more than 20 if the calyx-teeth over 1.8 mm. long; wide-spread, but not in Florida (2)
2. Calyx-teeth 0.8–2 mm. long, exceptionally up to 2.5 mm. long but less than 2 mm. in Texas; *petals* purple or purplish, rarely white, the banner 8.2–15.5 mm., the keel 5.5–9.3 mm. (but in Texas not over 10 mm. and 7 mm. respectively) long; widespread 301. *A. distortus*
2. Calyx-teeth (2) 2.4–4 mm. long; *petals* greenish-white or cream-colored, the banner 11.5–17.5 mm., the keel $\pm$ 8.5–12.5 mm. long; local in e. Texas 302. *A. Soxmaniorum*
1. Pod very prominently reticulate when ripe; *flowers* small, the banner 8.5–11 mm. long; *calyx-teeth* (1.8) 2.2–2.8 mm. long; *ovules* 14–18; Florida (and perhaps extreme s. Georgia) to s.-e. Mississippi 303. *A. obcordatus*

301. ASTRAGALUS DISTORTUS

Low, diffuse, with a taproot and knotty root-crown or shortly forking caudex, sparsely strigulose with fine, straight, appressed or subappressed hairs up to 0.2–0.45 mm. long, the stems often glabrous below the middle, the herbage green, the leaflets glabrous above; *stems* several, slender or moderately robust, decumbent or prostrate, radiating, (0.25) 0.5–3 (3.5) dm. long, commonly bearing short branchlets or spurs near the base, simple distally, together forming loose mats; *stipules* (1.5) 2–8 mm. long, green or purplish, the lowest becoming papery, mostly ovate- or broadly triangular-acuminate or the uppermost (all) lanceolate, decurrent around $\frac{1}{2}$, or the lowest around the whole stem's circumference, the blades commonly recurved, glabrous dorsally, thinly ciliate; *leaves* of the principal stems (2) 4–10 (13.5) cm. long (those of the subbasal branchlets often smaller and with smaller leaflets), with slender but sometimes short petiole and (9) 13–25 (27) oval, obovate, elliptic-oblongate, or suborbicular, truncate or retuse, flat leaflets (2) 3–11 mm. long; *peduncles* (2) 5–14 cm. long, decumbent or prostrate in fruit, a little longer or shorter than the leaf; *racemes* (5) 10–21-flowered,

rather dense at early anthesis, becoming looser in age, the flowers ultimately spreading and declined, the axis 1.5–5 (7.5) cm. long in fruit; *bracts* submembranous, ovate-acuminate or lanceolate, 1–3 mm. long; *pedicels* straight, ascending, or a trifle arched outward, at anthesis 0.8–1.4 mm., in fruit somewhat thickened, 1.5–2.4 mm. long; *bracteoles* 0–2, minute when present; *calyx* 3.1–6.3 mm. long, strigulose with white or mixed black and white hairs, the oblique disc 0.5–0.9 mm. deep, the triangular-subulate or subulate teeth $\frac{1}{3}$ – $\frac{1}{2}$ as long as the campanulate tube, the ventral pair often broadest and shortest, the whole becoming papery, marcescent, ruptured or not; *petals* pink-purple with pale wing-tips and pale, striate eye in the banner, all lilac-tinged, or all whitish with lavender keel-tip, rarely all white; *banner* recurved through $\pm 45^\circ$, ovate-cuneate or rhombic-ovate, deeply notched, 8.2–15.3 mm. long; *wings* shorter, the blades oblong-ob lanceolate, linear-oblong, or obliquely oblong-elliptic, gently incurved, obtuse and entire, undulate-erose, or (when broad) obliquely emarginate; *keel* much shorter than the banner, 5.5–9.3 mm. long, the half-obovate blades rather abruptly incurved through 95 – 105° to the blunt apex; *pod* normally ascending and humistrate, rarely declined of its own weight from ascending peduncles, sessile on an incipient or short gynophore 0.4–1.4 mm. long, varying in profile from narrowly lunate-elliptic to obliquely oblong-, ovate-, or obovate-elliptic, 13–25 mm. long, 3.5–7 mm. in diameter, shallowly sulcate only dorsally, or more deeply sulcate along both sutures, the green, thinly fleshy, glabrous valves becoming leathery, brownish and ultimately almost black, not inflexed, or inflexed as an incipient septum up to 1 mm. wide; *dehiscence* apparently apical, very tardy, after falling and weathering on the ground; *ovules* 16–37; *seeds* brown, sometimes purple-speckled, smooth or sparsely pitted, dull, 1.6–2.6 mm. long.

The Ozark milk-vetch, *A. distortus*, is variable in color and length of the petals, and in length and outline of the pod. The shorter type of pod, which is often but not quite always correlated with a relatively small flower, tends to be widest above the middle and thus obliquely obovate in profile; it is only shallowly grooved, commonly on the dorsal side alone, more rarely along both sutures, and is strictly unilocular. A longer and proportionately narrower pod of lunately elliptic profile is nearly always more deeply grooved both dorsally and ventrally, thus yielding a didymous cross-section, and is often narrowly septiferous within. The depth of the grooving along either suture, which increases as the valves dry out with advancing maturity, is apparently a function of the pod's length-width ratio and of a corresponding shift in the tensions set up in the shrinking tissues. Thus the sulcus, on which Rydberg placed so much emphasis, furnishes a differential character of secondary importance. A full series of intermediate forms links the extreme phases of the fruit, and there is no abrupt discontinuity either in flower-size or ovule-number. In consequence the key, which attempts to separate a small-flowered, prevailing Texan var. *Engelmanni* from the more widely dispersed var. *distortus*, cannot always provide satisfactory contrasts.

Key to the Varieties of *A. distortus*

1. Flower relatively large, the banner 11–15.5 mm., the keel (7) 7.4–9.3 mm. long; *pod* deeply sulcate both dorsally and ventrally, the valves often inflexed as a narrow incipient septum and the sutures approximate or in contact internally, the cross-section didymous; *ovules* mostly (26) 28–37, in the Allegheny Mountains only 18–26; Oklahoma and Louisiana n.- and n.-e.-ward 301a. var. *distortus*
1. Flower smaller, the banner 8.2–11.6 (12) mm., the keel 5.5–7 (7.2) mm. long; *pod* shallowly sulcate dorsally but not or only obscurely so ventrally, the sutures not approximate within, the cross-section obcordate, or suborbicular slightly constricted at the sutures, the valves not inflexed; *ovules* 16–28; e. Texas and immediately adjoining Louisiana and Arkansas 301b. var. *Engelmanni*

301a. *ASTRAGALUS DISTORTUS* var. *DISTORTUS*

Habit of the species; *calyx-tube* 2.8–3.8 mm. long, 2.1–3.2 mm. in diameter, the teeth 1.2–1.9 (2.5) mm. long; *banner* (10.5) 11–15.5 mm. long, (4.2) 5.2–8.4 mm. wide; *wings* (9) 10–13.7 mm. long, the claws (2.5) 3–4.1 mm., the

blades (6.6) 7.6–9.8 mm. long, 2–3.5 mm. wide; *keel* (7) 7.4–9.3 mm. long, the claws (3) 3.3–4.2 mm., the blades 4.3–5.7 mm. long, (2.1) 2.3–3 mm. wide; *pod* 1.3–2.5 cm. long, 4–7 mm. in diameter.—Collections: 83 (ii); representative: *Hopkins & A. & R. Nelson 1023* (SMU, TEX, WIS); *Goodman & Waterfall 4703* (OKLA, TEX); *Barneby 12,586* (CAS, NY, RSA), *12,587* (CAS, RSA); *Demaree 21,978* (CAS, NY); *Small & Wherry 11,759* (NY); *Horr 3604* (CAS, OKLA, TEX, WS).

Prairies, pastures, gullied stream banks, and sandy or sandy clay flats in open pine and oak woods, widespread and locally plentiful in Oklahoma, Missouri, and extreme southeastern Kansas, north (becoming rarer) to Iowa and central Illinois, and known from outlying stations (possibly introduced) in southern Louisiana and eastern Mississippi; greatly isolated, on shale barrens and in shaley pastures, in the foothills of the Allegheny Mountains in western Maryland, northern Virginia, and northeastern West Virginia.—Map No. 138—Late March to July.

ASTRAGALUS DISTORTUS (twisted, of the pod) T. & G., Fl. N. Amer. 1: 333. 1838.—“Arkansas, Nuttall! Dr. Leavenworth! Texas, Drummond! Dr. Leavenworth!”—Lectotypus, labeled in Nuttall’s hand “*Astragalus obcordatus* Ell. Arkansa.,” NY! The Texan paratype represent var. *Engelmanni*; isotypi, labeled by Nuttall “*Phaca *humifusa*. Ark.,” PH, “*Astragalus *arkansanus*,” G, and “*Astragalus* . . . quite new . . . Nuttall. Ark.,” PH!—*Tragacantha distorta* (T. & G.) O. Kze., Rev. Gen. 944. 1891. *Holcophacos distortus* (T. & G.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903.

Astragalus distortus fma. *albiflorus* (white-flowered) R. L. McGregor in Trans. Kans. Acad. Sci. 60: 161. 1957.—“ . . . 8 miles west of Weir, Cherokee County, Kansas, April 30, 1955, R. L. McGregor 9935.”—Holotypus (KANU), not examined.

The Ozark milk-vetch, var. *distortus*, is variable in color of the petals which change, from one population to the next, from a lively pink-purple to a lilac so pale as to seem white in bright sunshine; true albinism occurs more rarely, when the plant loses the last trace of anthocyanic pigment and the stems and herbage assume a characteristic pallor. The fma. *albiflorus* described from Bourbon, Crawford, and Cherokee Counties in Kansas is probably the pallid rather than the full albino phase.

The populations of *A. distortus* isolated from the main range of the species in northeastern West Virginia and adjoining states probably represent a distinct race, although this seems too little modified morphologically to deserve taxonomic notice. The flowers are on the small size of normal for var. *distortus*, thus approaching var. *Engelmanni*. The narrow, bisulcate pod, however, seems not to differ from that of the Ozark plant except that the ovules are fewer, 18–26 as opposed to 28–36.

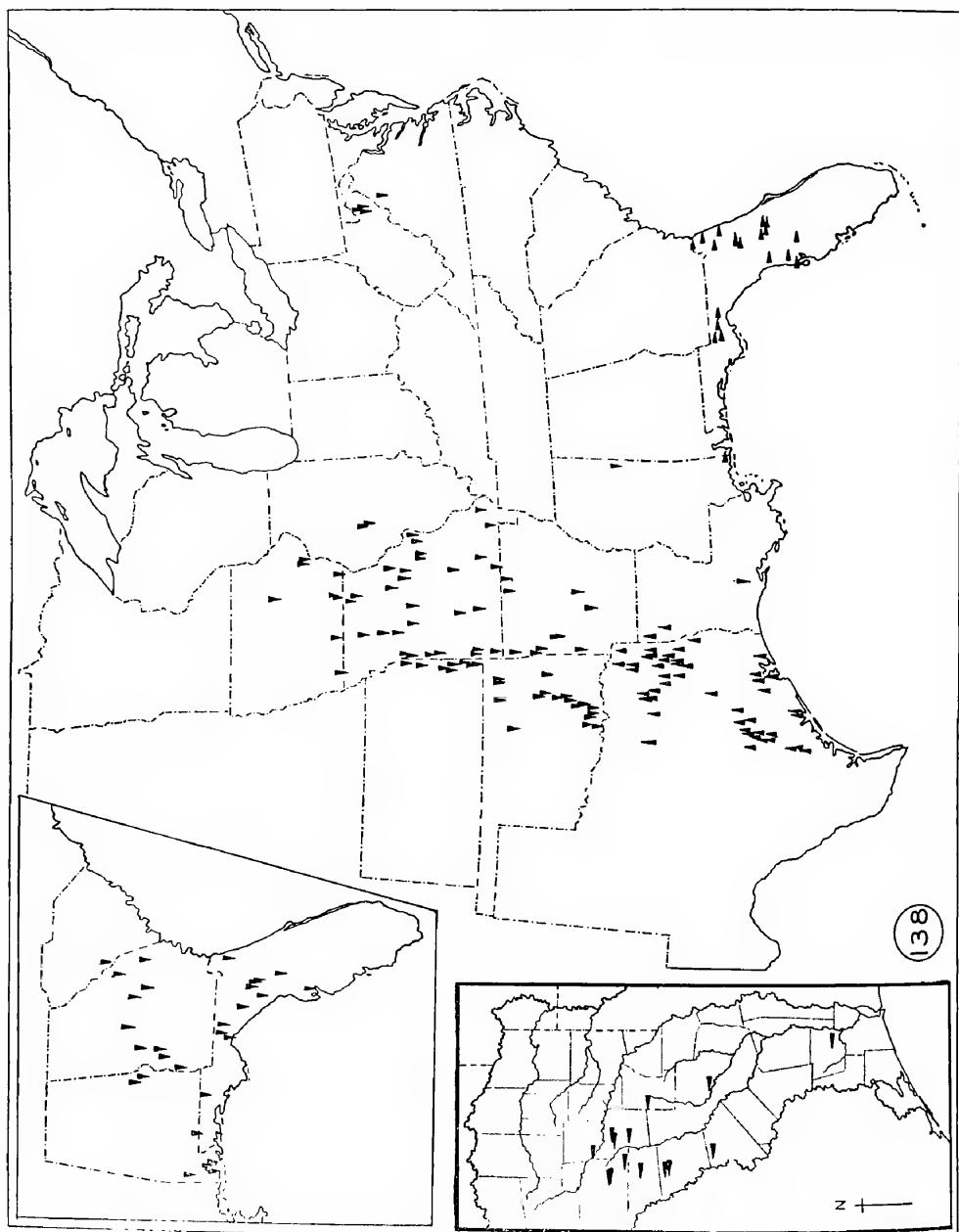
301b. *ASTRAGALUS DISTORTUS* var. *ENGELMANNI*

Closely resembling var. *distortus*, usually quite slender; *calyx* 3–4.5 mm. long, the tube (2) 2.4–3.4 mm. long, 1.8–2.3 (2.5) mm. in diameter, the teeth 0.7–1.5 (1.8) mm. long; *petals* purple with pale or whitish wing-tips; *banner* 8.2–11.6 (12) mm. long, 4–6.9 mm. wide; *wings* 7–9.8 mm. long, the claws 2.5–3.2 mm., the blades 5–7.7 mm. long, 1.6–2.5 mm. wide; *keel* 5.5–7 (7.2) mm. long, the claws 2.5–3.4 mm., the blades 3.3–4.5 mm. long, 1.8–2.4 mm. wide; *pod* 1.3–2 cm. long, 3.5–5.5 (6) mm. in diameter, gently or quite strongly incurved, often widest a little above the middle and subclavate-oblongate in outline.—Collections: 67 (ii); representative: *Tharp & Barkley 47,138* (SMU, TEX, WS); *G. Fisher* (from Houston) in 1930 (CAS, OKLA); *Cory 55,520* (SMU, WS); *Tharp* (from Ballard, Texas) in 1933 (NY, TEX); *E. J. Palmer 7077* (CAS), *11,455* (NY), *13,155* (WIS); *Shinners 11,171, 14,346* (SMU).

Habitats of var. *distortus*, usually in open pine or oak woods, common and locally plentiful in eastern Texas, from the San Antonio River in Goliad County and Matagorda Bay north to Fort Worth and the northeast corner of the state,

extending just into northwestern Louisiana and (presumably adjoining) Arkansas.
—Map No. 138.—(February) March to May.

ASTRAGALUS DISTORTUS var. ENGELMANNI (Sheld.) Jones, Rev. Astrag. 256, Pl. 65. 1923, based on *A. Engelmanni* (George Engelmann, 1809–1884, physician and preeminent XIX-century botanist) Sheld. in Minn. Bot. Stud. 1: 152. 1894.—“Collected on the Brazos, Texas, April 1839, February 1844. Also in open woods near Houston, Texas, March, 1842, by Ferdinand



Map No. 138. Right, eastern United States. Range of *A. distortus*: $\blacktriangle$ var. *distortus*; $\blacklozenge$ var. *Engelmanni*; and of $\diamond$ *A. obcordatus*. Inset, bottom left, parts of eastern Texas. Range of *A. Soxmaniorum*. Inset, top left, southeastern United States. Range of *A. villosus* (South Carolina stations, courtesy of H. E. Ahles).

Lindheimer . . ."—Holotypus, *Lindheimer* 70, from Houston, in February, 1844, MO (2 sheets); probable isotypi, *Lindheimer* from Houston, numbered No. 414, SMU! and from Brazos, dated April, 1844, NY! paratypi, *Lindheimer* in April, 1839, and in March, 1842, MO! —*Holcophacos Engelmanni* (Sheld.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903.

The Engelmann milk-vetch, the commonest perennial astragalus of the wooded sections of eastern Texas, is distinguished from var. *distortus* mainly by its slightly smaller flower and usually fewer-ovulate pod. The average pod is a little shorter and proportionately wider than that of var. *distortus*, and when ripe it is ordinarily sulcate only along the dorsal suture. Occasional specimens (e.g., *L. McLean* in 1933, OKLA, from near the variety's south limit in Bexar County) combine the short flower of var. *Engelmanni* with the long, narrow, bisulcate fruit of var. *distortus*. The pod of var. *Engelmanni* is similar in form to that of *A. obcordatus*, native farther east along the Gulf Coastal Plain from Mississippi to Florida, but is less prominently reticulate when ripe; and the petals are more strongly graduated, with keel very much shorter than the banner. The differential characters of the closely related and sympatric *A. Soxmaniorum* are mentioned under the next species.

Although so common in eastern Texas, the Engelman milk-vetch extends rarely beyond the state borders. Only one collection (*F. L. Harvey* in 1883, WS) has been seen from Arkansas, and since this lacks precise locality data, the record is omitted from the map. Jones (l.c.) reported the variety from Oklahoma, but the Carleton specimens from the Indian Territory (Vinita, Oklahoma, No. 30, NY) are typical var. *distortus*. The earliest collections of var. *Engelmanni*, brought back from Texas by Drummond and Leavenworth, formed part of the original concept of *A. distortus* T. & G. A Nuttall collection, apparently representing var. *Engelmanni* but of uncertain provenance, is mentioned in Appendix I under *A. debilis* Nutt.

302. ASTRAGALUS SOXMANIORUM

Perennial but probably of short duration, diffuse, thinly strigulose-hirsutulous with fine, mostly straight, loosely ascending and subappressed hairs up to 0.5–0.7 mm. long, the herbage green, the leaflets sparsely pubescent near the margins and along the midrib beneath, glabrous above; *stems* few or numerous, prostrate and radiating or weakly ascending from the crown of a slender taproot, (3) 7–20 cm. long, simple or branched near the base, floriferous upward from near the middle; *stipules* thinly herbaceous becoming papery, ovate-acuminate to linear-lanceolate, 2.5–6.5 mm. long, glabrous dorsally, $\pm$ semiamplexicaul; *leaves* (2.5) 3.5–9 (11.5) cm. long, shortly petioled, with (9) 13–19 (21) obovate, obovate-cuneate, or oblong-obovate, deeply notched, flat leaflets (2) 4–15 mm. long; *peduncles* rather stout, incurved-ascending and ultimately procumbent, (3) 4.5–9.5 cm. long; *racemes* shortly but loosely 8–20-flowered, the flowers early spreading, declined in age, the axis a little elongating, (1) 1.5–4 (4.5) cm. long in fruit; *bracts* ovate or lanceolate, broadly membranous-margined, 2–4 mm. long, deflexed in fruit; *pedicels* at anthesis ascending or slightly arched outward, 0.5–1.3 mm. long, in fruit straight and ascending, or divaricate, or strongly arched outward, a little thickened, 1.2–2.6 mm. long, persistent; *bracteoles* 0–2; *calyx* (5.8) 6.1–9 mm. long, thinly strigulose with white and often some fuscous hairs, the subsymmetric disc 0.7–1.2 mm. deep, the campanulate, membranous, pallid tube 3.3–4.8 mm. long, 2.4–3.9 mm. in diameter, the firmer, green, lanceolate or lance-caudate teeth (2) 2.4–4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* greenish-white or cream-colored, immaculate; *banner* recurved through $\pm$ 45°, rhombic-ovate, -obovate, or broadly rhombic-oblancheolate, notched, 11.4–17.4 mm. long, 6.8–9.4 mm. wide; *wings* 9.8–13 mm. long, the claws 3.9–5.7 mm., the narrowly oblong, oblong-oblancheolate, or lance-oblong, obtuse or obscurely emarginate, slightly incurved blades 7–9.4 mm. long, 2.1–3.4 mm. wide; *keel* 8.6–12.7 mm. long, the claws 3.9–5.9 mm., the half-obovate or -elliptic blades 5.2–7.5 mm. long, 2.2–3.4 mm. wide, incurved through 85–90° to the rounded or sharply deltoid, sometimes slightly porrect apex; *anthers* (0.45) 0.5–0.7 mm. long; *pod* ascending (humistrate), or (when pressed) apparently spreading or declined, sessile on a stout gynophore 0.6–1.6 mm. long, the body

half-obovate or lunately oblanceolate in profile, with straight or gently concave ventral and strongly convex dorsal sutures, 1.5–2.1 cm. long, 5–8 mm. in diameter, broadest above the middle and tapering downward into the cuneate base, abruptly contracted distally into a rigid cusp 1.5–2.5 mm. long, the whole a trifle compressed laterally and obscurely trigonous, with rounded lateral and flattened or shallowly grooved dorsal faces, the green, somewhat fleshy, glabrous valves becoming leathery, reticulate, stramineous or blackish-brown, inflexed (especially toward the base) as a very narrow and incomplete septum 0.4–1.3 mm. wide; *dehiscence* apical, basal, and ultimately through the ventral suture, the dorsal suture also splitting to reveal the septum's outer walls; *ovules* 18–26; *seeds* brown or olivaceous, often so heavily mottled or dotted with black-purple as to appear black, smooth but dull, 2.2–2.7 mm. long.—Collections: 15 (i); representative: *Cory* 52,870 (SMU, WS), 52,875 (SMU), 57,049 (OKLA, SMU); *Barneby* 11,044 (CAS, RSA); *J. W. Hardin* 525 (GH, US).

Openings in sandy oak woods and along sandy roadsides or in abandoned fields and clearings, $\pm$ 250–550 ft., locally plentiful in scattered stations in north-eastern Texas, from the Sabine to the Trinity River.—Map. No. 138.—March to early May.

ASTRAGALUS SOXMANIORUM (Dr. and Mrs. G. M. Soxman, amateur pteridologists of Dallas) Lundell in Field & Lab. 13: 3. 1945.—“TEXAS: Nacogdoches County, off U. S. Highway 59, about 8 miles south of Nacogdoches, along sandy roadside, March 22, 1941, *C. L. Lundell* and *Amelia A. Lundell* 9750 ... Anderson County, 17 miles southeast of Athens, April 13, 1942, *Lundell* & *Lundell* 11151 ... Van Zandt County, off highway 64, near Edom, in sandy fallow field, March 24, 1944, *Lundell* & *Lundell* 12701 (type in the herbarium of Southern Methodist University).”—Holotypus (SMU), not examined, but the description decisive.

The Soxman milk-vetch is closely related to *A. distortus*. The two species are alike in habit and all details of organization, and the pod of *A. Soxmaniorum* cannot be distinguished in practice from that of the sympatric *A. distortus* var. *Engelmanni*, from which the plants differ appreciably only in the larger flower, proportionately longer calyx-teeth, and ochroleucous petals. The differences are of a sort and of a magnitude which one might expect in allopatric geographic varieties of one species, but *A. Soxmaniorum* and *A. distortus* var. *Engelmanni* are found in similar habitats within the same range. Since no evidence whatever of intermediate forms is available, it may be assumed that the two entities are kept apart by some isolating mechanism, presumably of a genetic nature. As observed in Van Zandt County and afterwards in cultivation (RSA), *A. Soxmaniorum* is clearly self-perpetuating and breeds true to seed. It is interpreted with some confidence as a fixed mutation, stemming presumably from *A. distortus* var. *Engelmanni*, which has achieved an independent area of dispersal within that of its progenitor. The species was collected first in 1901, near Mineola, Wood County, by J. Reverchon.

303. ASTRAGALUS OBCORDATUS

Low, slender, diffuse, with a taproot and shortly forking caudex, glabrous except for a few scattered, subappressed and ascending hairs up to 0.3–0.5 mm. long on the leaf-stalks, the midrib of the leaflets beneath, and the inflorescence, the herbage green; *stems* several or numerous, prostrate or decumbent, 0.4–4 (5) dm. long, simple or spurred at 1–3 nodes preceding the first peduncle; *stipules* thinly herbaceous or the lowest papery, pallid or brownish, 2–4 (6) mm. long, ovate-triangular or lanceolate, $\pm$ semiamplexicaul-decurrent; *leaves* 5–12 (15) cm. long, slender-petioled, with (9) 15–27 rather distant and often scattered, oblong-obovate and retuse, cuneate-obcordate, or obcordate, flat leaflets 2–7 (10) mm. long; *peduncles* incurved-ascending, (1.5) 3–10 (12.5) cm. long, shorter than the leaf; *racemes* shortly but loosely 5–15 (18)-flowered, the flowers spreading or declined in age, the axis 1–4.5 (6) cm. long in fruit; *bracts* submembranous, often purple-margined, ovate, ovate-acuminate, or lanceolate, 1.2–2.5 (3.5) mm. long; *pedicels* at anthesis slender, ascending, 1–1.5 (1.8) mm. long, in fruit ascending or strongly arched outward, a trifle thickened, 1.5–2.8

mm. long, persistent or tardily disjoining; *bracteoles* 2, small, or 0; *calyx* 4.7–6.1 mm. long, thinly strigulose with white hairs, the subsymmetric disc 0.6–1 mm. deep, the submembranous, campanulate tube 2.7–3.5 mm. long, 2.2–2.8 mm. in diameter, the broadly subulate or lanceolate, herbaceous teeth (1.8) 2.2–2.8 mm. long, the whole becoming papery, marcescent usually unruptured; *petals* pinkish or bluish-lilac, the color early fading; *banner* recurved through 45–50° (or further in withering), obovate-, ovate-, or rhombic-cuneate, openly and shallowly notched, rarely subtruncate, 8.5–10.8 (11) mm. long, 4.5–6 mm. wide; *wings* 8–9.7 mm. long, the claws 3–3.4 mm., the obliquely oblanceolate or narrowly obovate, erose-undulate or obscurely emarginate, gently incurved or nearly straight blades 5.8–7.4 mm. long, 1.8–2.5 mm. wide; *keel* 6.5–8 mm. long, the claws 3–3.6 mm., the half-obovate blades 4–5.2 mm. long, (2) 2.2–2.7 mm. wide, abruptly incurved through 85–95° to the rounded apex; *anthers* 0.4–0.55 mm. long; *pod* ascending or loosely spreading (commonly humistrate), sessile on the conical receptacle or an incipient gynophore up to 0.6 mm. long, lunately half-ellipsoid or widest a trifle above the middle and nearly half-obovoid, (1.3) 1.6–2.5 (2.7) cm. long, (4) 4.5–7 (7.5) mm. in diameter, obconic or cuneately tapering at base, contracted distally into an erect or incurved cusp 0.3–2 mm. long, a little turgid but somewhat laterally compressed, carinate ventrally by the gently concave suture, shallowly and narrowly sulcate dorsally, the thinly fleshy, green or purple-tinged, glabrous valves becoming stiffly papery, stramineous or ultimately brownish, coarsely reticulate, inflexed at base of the pod as a rudimentary septum 0.2–0.6 mm. wide; *dehiscence* apical, tardy; *ovules* (13) 14–18 (19); *seeds* brown or soot-black, smooth or minutely pitted, dull, 1.6–2.5 mm. long.—Collections: 27 (o); representative: *Curtiss* 597 (ND, NY, SMU); *Barnhart* 1330, 2637 (NY); *Small* 11,399 (NY); *Small & al.* 11,268 (NY); *G. V. Nash* 307 (ND, NY).

Sandy pine woods of the Atlantic and Gulf Coastal Plains, apparently local, northern, western, and central peninsular Florida, south to Tampa Bay and Polk County, and probably in extreme southern Georgia; apparently isolated in southeastern Mississippi (near Pascagoula).—Map No. 138.—February to April.

ASTRAGALUS OBCORDATUS (inversely heart-shaped, of the leaflets) Ell., Bot. S. C. & Ga. 2: 227. 1823.—“sent to me from St. Mary’s by the late Dr. Baldwin . . . in the Southern Districts of Georgia, near St. Mary’s.”—Spm. authent., labeled “838 *Vicia?* In flower March 14, 1813, south side of St. Mary’s River.” PH (herb. Muhlenberg.)! The corresponding entry in Muhlenberg’s Observations indicates the collector as William Baldwin and the species as “new to Elliott.”—*A. Elliottii* (Stephen Elliott, 1771–1830) D. Dietr., Syn. Pl. 4: 1080. 1847, a superfluous substitute, Dietrich having misread the epithet as *odoratus*, already used in the genus.—*Tragacantha obcordata* (Ell.) O. Kze., Rev. Gen. 946. 1891. *Tium obcordatum* (Ell.). Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903. *Batidophaca obcordata* (Ell.) Rydb. in N. Amer. Fl. 24: 321. 1929.

The Florida milk-vetch, *A. obcordatus*, was placed by Jones (1923, p. 129, Pl. 26) and by Rydberg (1929, p. 321) in a section or genus so far apart from *A. distortus* that its close relationships, which were discerned by Gray (1864, p. 208), became altogether obscured. The species is similar to *A. distortus* and *A. Soxmaniorum* in habit of growth, and is most reliably distinguished by the prominently elevated reticulation of the mature fruit; it differs from the equally small-flowered *A. distortus* var. *Engelmanni* by its relatively long calyx-teeth and less strongly graduated petals.

Only one specimen of *A. obcordatus* collected outside of Florida is known to exist, *Small & Wherry* 11,726 (NY) from near Pascagoula, Mississippi; there is no record of the species from extreme western Florida or southern Alabama. If Baldwin’s original station was really to the south of St. Mary’s River as stated (in herb.) by Muhlenberg, the type-locality is in the present Duval County, Florida, where *A. obcordatus* has been collected several times in recent years, and not, as claimed, in the state of Georgia. The Florida milk-vetch approaches the Georgia State line in the Tallahassee region of western Florida and is to be sought north of the boundary in Grady and Decatur Counties.

LXXV (ii). Subsect. *VILLOSI*

Characters as given in the subsectional key.—Sp. 1, xerophyte, of southeastern United States (Florida, Georgia, Alabama).

ASTRAGALUS sect. *VILLOSI* (Rydb.), comb. nov., based on *Batidophaca* sect. *Villosae* Rydb. in N. Amer. Fl. 24: 318. 1929.—Sp. typica: *B. villosa* (Mchx.) Rydb. = *A. villosus* Mchx.

Batidophaca Rydb. in N. Amer. Fl. 24: 314. 1929.—Generitypus: *B. villosa* (Mchx.) Rydb. = *A. villosus* Mchx.—*Astragalus* subgen. *Batidophaca* (Rydb.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 203. 1941.

The genus *Batidophaca* was designed by Rydberg to accommodate miscellaneous astragali which had been excluded either from *Phaca* because of the little inflated pod, or from *Xylophacos* because of the short and broad proportions of the flower, or from *Hamosa* because of the unilocular (sometimes actually subunilocular) fruit. It was an artificial and extremely heterogeneous group, the members of which are now dispersed among seven sections, and is listed in the synonymy of sect. *Villosi* simply because it is based on the same typus, *A. villosus*. The sect. *Villosae*, being the typical section of *Batidophaca*, was nomenclaturally superfluous when published, so that sect. *Villosi* should perhaps be accounted an independent proposition dating from these pages, even though it is based on Rydberg's description (sens. restr.).

304. *ASTRAGALUS VILLOSUS*

Slender, diffuse, caulescent, perennial but of short duration, sometimes flowering the first season, with a shortly penetrating, often branching taproot and at length loosely forking caudex or knotty root-crown usually buried in litter (perhaps sometimes shortly subterranean), the herbage green, but the upper internodes, the leaf-rachises, the lower leaf-surfaces, and the peduncles hirsute with fine, spreading and ascending, often spirally twisted hairs up to 1.1–2 mm. long, the inflorescence silvery-pilose; *stems* few or several, decumbent or prostrate, 2–15 cm. long, leafless for a space of 0–7 cm., simple or shortly spurred at the lowest leafy axils, together forming loosely woven mats or depressed tufts; *stipules* herbaceous, or the lowest becoming papery-membranous, broadly ovate, ovate-acuminate, or lanceolate, (1) 2–8.5 mm. long, decurrent around $\frac{1}{2}$ – $\frac{2}{3}$ the stem's circumference, the lowest rarely fully amplexicaul and even shortly united, all glabrous or nearly so dorsally, hirsute-ciliate, the margins sometimes beset with a few minute tack-shaped processes; *leaves* (1.5) 3–10 (12) cm. long, slender-petioled, with 7–15 (or in some early leaves, or in some juvenile plants, only 3–7) obovate, broadly oblanceolate, or suborbicular, mostly retuse-emarginate, sometimes truncate, flat, thin-textured, often visibly penninerved leaflets (2) 5–22 mm. long, the terminal one usually larger than the last pair; *peduncles* slender, (2) 3–11 cm. long, incurved-ascending at anthesis, procumbent in fruit; *racemes* (5) 8–24-flowered, rather dense at early anthesis, the flowers ultimately horizontal or declined, the axis little elongating, 1–3 (4) cm. long in fruit; *bracts* herbaceous, lanceolate or linear-lanceolate, (2) 2.5–5 mm. long, long-ciliate, deflexed in fruit; *pedicels* at first ascending and then arched outward, at anthesis 0.7–1.5 mm., in fruit either ascending or divaricate, a little thickened, up to 2.5 mm. long, persistent; *bracteoles* 0; *calyx* 5.5–7.8 (8.2) mm. long, ascending-hirsute, the scarcely oblique disc (0.5) 0.8–1.3 mm. deep, the campanulate, submembranous, often purplish tube 2.7–3.7 (4) mm. long, 2.5–3.3 mm. in diameter, the firm, lanceolate, triangular-lanceolate, or lance-attenuate teeth (2.7) 3–4.5 (5) mm. long, the whole a trifle accrescent, in fruit papery, marcescent usually unruptured; *petals* pale yellow or greenish-ochroleucous, immaculate; *banner* recurved through 50–80°, ovate cuneate, notched, 8.8–11.2 mm. long, 5–7 mm. wide; wings (as long or a trifle longer) 8.8–11.5 mm. long, the claws 2.6–3.4 mm., the broadly oblanceolate, elliptic, or obliquely triangular, obtuse or sometimes subacute or obliquely emarginate blades 6.7–8.5 mm. long, 2.5–3.3 mm. wide, the left one more strongly in-

curved than the right and its inner margin infolded; *keel* 7.2–9.7 mm. long, the claws 2.8–4.2 mm., the lunately half-elliptic blades 4.6–5.8 mm. long, 2.2–3.5 mm. wide, incurved through 80–110° to the narrowly deltoid, acute or subacute, often slightly porrect apex; *anthers* 0.45–0.6 (0.65) mm. long; *pod* spreading or ascending (humistrate, sometimes appearing declined in pressed spms.), sessile on the conical receptacle, or elevated on a stout, glabrous gynophore up to 0.8 mm. long, slenderly lunate- or half-ellipsoid, (1.5) 1.7–2.4 cm. long, (2.8) 3.2–5.2 mm. in diameter, gently incurved or nearly straight, broadly or narrowly cuneate at base, tapering distally into a lance-subulate, slightly declined beak $\pm$ 3–5 mm. long, bluntly triquetrous, keeled ventrally by the suture, openly and shallowly sulcate dorsally, the thinly fleshy, pale green valves hirsute with lustrous, spreading-ascending hairs up to 1.2–1.8 mm. long, becoming stramineous and ultimately brownish, stiffly papery, prominently reticulate, inflexed as a rudimentary septum up to 0.3 mm. wide; *dehiscence* tardy, apical and downward through the ventral suture; *ovules* 12–18; seeds brown, sometimes purple-speckled, 1.7–2.2 mm. long.—Collections: 34 (iii); representative: *Curtiss* 601 (NY, SMU); *Small & al.* 11,175, 11,195 (NY); *Godfrey* 52,919 (NY); *Ripley & Barneby* 10,134 (CAS, RSA).

Glades, savannas, openings in sandy pine woods, sometimes along roadsides, scattered but locally plentiful, southern South Carolina through central Georgia to southwestern Alabama and western and northcentral Florida; reported from Tennessee (Mell in Bull. Ala. Agric. Exp. Sta. No. 70. 284).—Map No. 138.—Late February to May.

ASTRAGALUS VILLOSUS (softly hairy) Mchx., Fl. Bor.-Amer. 2: 67. 1803.—“Hab. in Georgia.”—Holotypus, P (herb. Mchx.)!—*Phaca villosa* (Mchx.) Nutt., Gen. 2: 97. 1818. *Tragacantha villosa* (Mchx.) O. Kze., Rev. Gen. 949. 1891. *A. intonsus* (unshaven) Sheld. in Minn. Bot. Stud. 1: 23. 1894, a superfluous substitute, the supposed obstacle, *A. villosus* Gueldenst., Reise Russl. 2: 187. 1791, being a nom. nud.—*Tium intonsum* (Sheld.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903. *Batidophaca villosa* (Mchx.) Rydb. in N. Amer. Fl. 24: 319. 1929.

The bearded milk-vetch, *A. villosus*, is a lowly but delightful little astragalus, notable for the few leaflets of membranous texture, bright green beneath the sparse but long and lustrous pubescence, for the rather small, primrose-yellow or greenish-creamy flowers, and for the narrowly ellipsoid, often shallowly crescentic, handsomely hirsute pods. In Georgia it is sometimes associated with the tall, erect *A. Michauxii*, in western Florida with the more nearly related and habitually similar *A. obcordatus*, but both of these have almost glabrous foliage, lilac or purple-tinged petals, and hairless ovary and pod. The leaflets of young plants, which often flower during the first year of growth, are ordinarily only 3–7 in number and comparatively ample, but these give place the following season to leaves composed of 7–15 leaflets, of which the terminal one is commonly much the largest. The taproot of *A. villosus* is unusually slender for a perennial astragalus and is sometimes several times forked, at the same time giving rise to many lateral rootlets. It makes the nearest approach to a fibrous root-system known in the American species of the genus.

LXXVI. Sectio LOTIFLORI

Low, tufted, acaulescent or shortly caulescent, potentially perennial but often flowering (and sometimes perishing) the first season, probably never enduring over 3 years; *vesture* dolabriform; *stipules* free; *leaves* imparipinnate, with (1) 3–17 leaflets; *inflorescence* and flowers dimorphic (though not in every individual plant or population), chasmo- or cleistogamous, in the first case bearing well-developed, pedunculate racemes of small but perfectly formed flowers (the banner $\pm$ 8.5–14 mm. long, varying in color from greenish-white to ochroleucous or purple), in the second the inflorescence reduced to an axillary, sessile cluster of few ($\pm$ 1–5) flowers fertilized in the bud and with ill-formed or minute petals

(the whitish banner $\pm$ 4.5–7 mm. long); *calyx-tube* campanulate, often a little accrescent but finally ruptured; *pod* sessile, ascending (commonly humistrate), deciduous from the receptacle, ovoid to narrowly oblong-ellipsoid, variably but nowhere greatly compressed, unilocular, the somewhat fleshy valves becoming stiffly papery or leathery; *dehiscence* primarily apical, ultimately through the length of the ventral suture; *ovules* 30–46 (56).—Sp. 1, a polymorphic xerophyte of the Great Plains and Mississippi Valley (Texas to Minnesota, Saskatchewan, and Alberta), extending west into extreme southern British Columbia, western Montana, the east slope of the Colorado Rocky Mountains, the Rio Grande Valley in New Mexico, and trans-Pecos Texas; isolated (possibly introduced) in southern Coahuila.

ASTRAGALUS sect. LOTIFLORI Gray in Proc. Amer. Acad. 6: 208. 1864.—Sp. lectotypica: *A. lotiflorus* Hook.—*Astragalus* sect. *Lotiflorus* Sheld. in Minn. Bot. Stud. 1: 151. 1894 (exclus. sp. plur.), an illegitimate substitute. *A. sect. Lotiflori* subsect. *Lotiflori* Jones, Rev. Astrag. 175, in clave. 1923. *Batidophaca* sect. *Lotiflorae* (Gray) Rydb. in N. Amer. Fl. 24: 321. 1929.

The singular little lotus milk-vetch, notable in the genus for its dimorphic inflorescences, is an isolated type fully deserving a monotypic section. The species was associated by Gray with *A. villosus*, similar in the form of the calyx and petals, but the latter differs importantly in its basifixed vesture and trigonously compressed, narrowly septiferous pod. Gray's section *Lotiflori* was emended by Jones (1923, l.c.) to exclude *A. villosus*; however, the elements (our *Circumdati* and *Accumbentes*) introduced in its place have little more in common with *A. lotiflorus* and were certainly misplaced. The section is here received in the sense of Rydberg's sect. *Lotiflorae* in *Batidophaca*, although only one polymorphic species instead of three is recognized.

The affinities of the *Lotiflori* are far from clear. The species resembles some *Argophylli* in growth-habit and form of the pluriovulate fruit, but the campanulate calyx and proportionately short flower are more nearly in agreement with sect. *Villosi* and other groups of the small-flowered piptoloboid series. The section is introduced directly following *A. villosus*, although the relationship in this direction is not particularly close.

305. ASTRAGALUS LOTIFLORUS

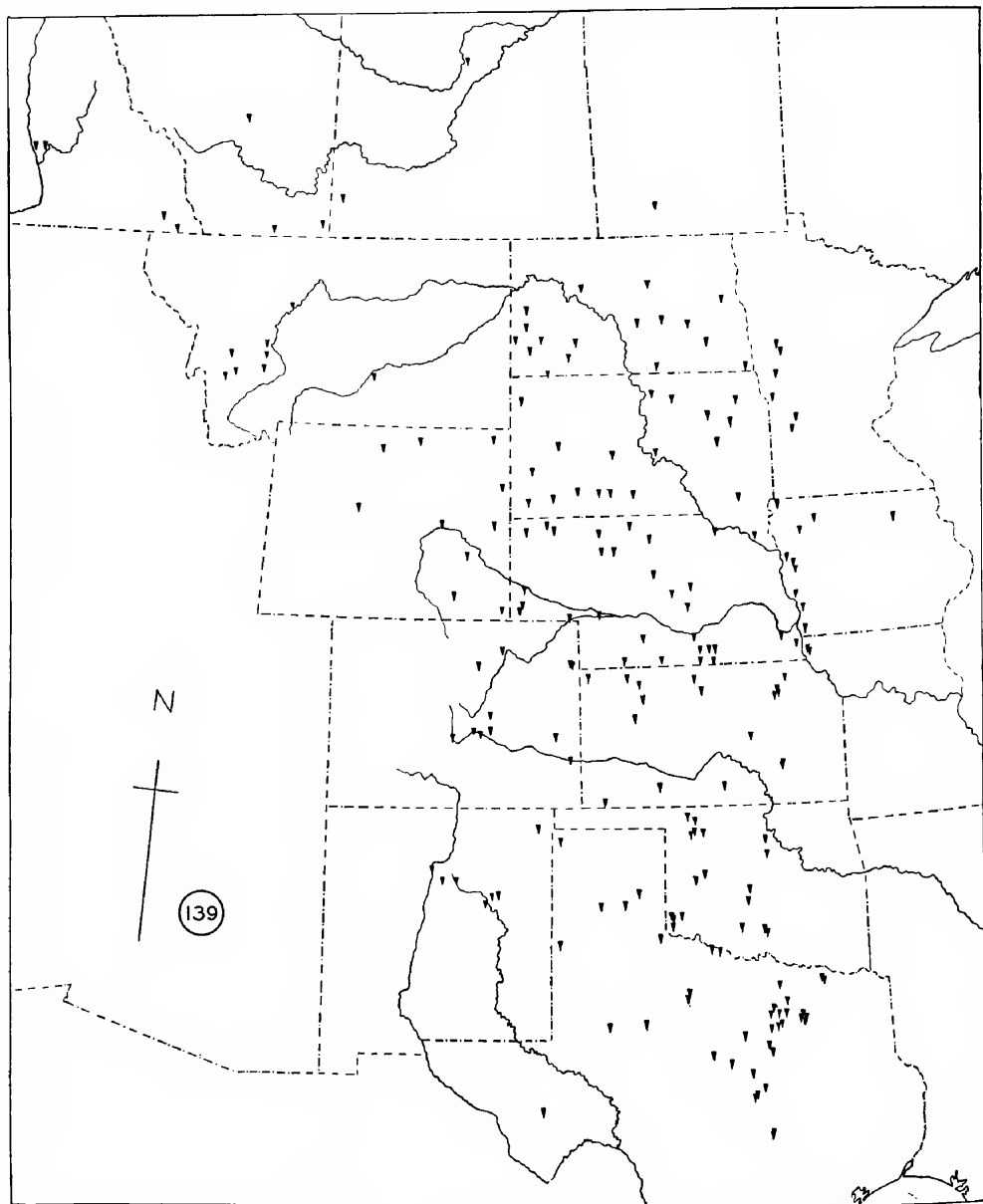
Low, loosely or densely tufted, with a taproot at first very slender becoming stouter, woody, and ultimately producing a shortly forking caudex, the herbage pubescent, usually densely so, with fine hairs affixed shortly above the base, very variable in length and orientation, the vesture strigulose, pilosulous, or hirsute, composed entirely or in part of appressed, ascending, or spreading, and entirely or in part of straight or sinuous hairs up to 0.5–2.2 (2.5) mm. long, the leaflets cinereous or canescent, the upper surface commonly of a lighter green than the lower and often medially glabrescent or glabrous; *stems* 1–several, almost 0 up to 7 (12) cm. long, in seedling plants often solitary and erect, in mature ones more numerous, the outer of the tuft decumbent or prostrate, the internodes all short, concealed by stipules or up to 1.5 (3.5) cm. long, mostly shorter; *stipules* submembranous, pale green, pallid, or purplish-tinged, becoming papery-scarious in age, broadly deltoid, ovate- or triangular-acuminate, or lanceolate, (2.5) 3–8 mm. long, $\pm$ semiamplexicaul-decurrent; *leaves* 2.5–11 (14) cm. long, with slender petiole and 7–17 or in many seedling (and some mature) plants only (1) 3–9 narrowly to broadly elliptic, oblanceolate, oval, or obovate-cuneate, flat or loosely folded leaflets 4–20 (26) mm. long, the terminal one commonly (but not quite always) longer than the last pair; *inflorescence* dimorphic: a) *chasmogamous* and b) *cleistogamous*, these found commonly on different plants or if on the same plant at different seasons of the year, most often in discrete colonies of like plants, but sometimes separately on different individuals in a colony, in seedling plants cleistogamous only; a) *chasmogamous* racemes borne on slender peduncles (3) 4–12 cm. long, these ascending at anthesis, procumbent in fruit, either longer or shorter than the leaf; *flowers* (3) 5–17, rather densely racemose, at first ascending and forming an ovoid or subcapitate head, subhorizontal in age,

the axis somewhat elongating, 7–25 mm. long in fruits; *bracts* thinly herbaceous or submembranous becoming papery, lanceolate or ovate-acuminate, 1.8–5 mm. long; *pedicels* at anthesis straight, ascending, 0.5–1.3 mm. long, in fruit thickened, sometimes arched outward, 1.2–2.4 mm. long, persistent; *bracteoles* usually 0, occasionally present at or below the base of the calyx; *calyx* 5–9.7 mm. long, often purple-tinged, the scarcely oblique disc 0.5–1 (1.2) mm. deep, the campanulate tube rounded at base, 3.2–4.5 mm. long, (2.2) 2.4–3 mm. in diameter, the lanceolate, often slightly incurved teeth 2.2–5.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* greenish-white, ochroleucous, or tinged or veined with lavender, sometimes brightly tipped or margined with purple or bluish-purple; *banner* recurved through 45° or sometimes further, ovate- or oblong-cuneate, shallowly or deeply notched, 8.5–14 mm. long, 4.6–6.4 mm. wide; *wings* 7.8–11.8 mm. long, the claws 3.1–4.4 mm., the oblanceolate, narrowly obovate, or rarely linear-oblong, obtuse, nearly straight or gently incurved blades 5.3–8.3 mm. long, 1.6–3 mm. wide; *keel* 6.6–9.8 mm. long, the claws 3.4–4.6 mm., the half-obovate blades (3.3) 3.6–5.9 mm. long, 2.1–3 mm. wide, abruptly incurved through 90–110° to the bluntly or exactly deltoid apex; *anthers* (0.4) 0.45–0.65 mm. long; b) *cleistogamous* racemes borne on short or subobsolete peduncles mostly shorter than the subtending stipules, occasionally up to 2 cm. long, the fruits in consequence subradical and concealed beneath the tufted foliage; *flowers* 1–3 (5), very shortly racemose; *calyx* at anthesis commonly shorter, but accrescent and as large in fruit, the tube at first narrower, obconic at base, 1.9–2.5 mm. in diameter; *petals* whitish (drying yellowish), not expanding, obscurely graduated, often shorter than the calyx-teeth; *banner* little recurved, oval, subentire, 4.3–7.2 mm. 2.5–3.8 mm. wide; *wings* 4.2–6.5 mm. long, the claws 1.5–2.9 mm., the blades 3–4.5 mm. long, 1–2 mm. wide; *keel* 4.2–6 mm. long, the claws 1.8–3.2 mm., the blades 4.2–3.6 mm. long, 1.3–1.9 mm. wide, the whole often carried up on the style of the forming fruit; *anthers* mostly smaller, 0.3–0.45 (0.5) mm. long; *pod* (alike on both types of inflorescence) ascending or loosely spreading (humistrate), ovoid-acuminate, ovoid-, lance-, or narrowly oblong-ellipsoid, 1.2–3.7 cm. long, 5–8 mm. in diameter, straight, lunately incurved, or rarely a little decurved, rounded or narrowly to broadly cuneate at base, either abruptly contracted or gradually tapering distally into a triangular- or lance-acuminate, somewhat compressed beak, dorsally flattened or openly depressed-sulcate (when obscurely trigonous) in the lower $\frac{1}{3}$ – $\frac{2}{3}$, carinate ventrally by the prominent, thick suture, the dorsal suture also prominent but thinner and commonly undulate, the green, somewhat fleshy, strigulose or stiffly papery, cross-reticulate and often wrinkled lengthwise, not inflexed; *seeds* ocher- or pale brown, often purple-speckled, irregularly pitted, dull or lustrous, 1.5–2.5 mm. long.—Collections: 133 (xxii); representative material cited in the discussion.

Prairies, barren hilltops, gullied bluffs, and gravelly outcrops on plains and hillsides, sometimes (northward) on sandy or pebbly lake shores, usually in light and porous or gravelly clay soils, sometimes in black loam, limestone silt, shaley gravels, or almost pure gypsum, mostly 700–6000 feet, but ascending westward along streams into the valleys of the southern Rocky Mountains up to 7800 feet, common on the prairies of central Texas and Oklahoma, north, becoming less frequent (but because of the prevalence of cleistogamy and inconspicuous fruits probably much overlooked), to Minnesota, southern Manitoba, and the Saskatchewan and Red Deer Valleys in Alberta, west across the Continental Divide to the lower Fraser and Kootenai Valleys in southern British Columbia, in Montana to the Bighole River in Beaverhead County, in Wyoming to the Big Horn and

Wind Rivers, in Colorado to the foothills of the Front Range and up the Arkansas Valley into Chaffee County, and in New Mexico to the upper Rio Grande; greatly isolated, perhaps introduced, in southern Coahuila at 6300 feet (*Ripley & Barneby 13,267*), this record not mapped.—Map No. 139.—April to July.

ASTRAGALUS LOTIFLORUS (with flowers of *Lotus*) Hook., Fl. Bor.-Amer. 1: 152. 1831.—“About Carlton-House on the Saskatchewan, *Drummond*.”—Holotypus, labeled “North America,” K!—*Phaca lotiflora* (Hook.) T. & G., Fl. N. Amer. 1: 349. 1838. *Astragalus lotiflorus* fma. *pedunculatus* (with peduncled racemes) Gray in Proc. Amer. Acad. 6: 209. 1864. *Tragacantha lotiflora* (Hook.) O. Kze., Rev. Gen. 946. 1891. *Cystopora lotiflora* (Hook.) Lunell in Amer. Midl. Nat. 4: 428. 1916. *Batidophaca lotiflora* (Hook.) Rydb. in N. Amer. Fl. 24: 321. 1929.



Map No. 139. The Rocky Mountain and Prairie States and Provinces. United States and southern Canada. Range of *A. lotiflorus* (the isolated Mexican record omitted).

Phaca cretacea (of chalky soil) Buckl. in Proc. Philad. Acad. 1861: 452. 1861.—“Cretaceous rocks, Northern Texas.”—Holotypus, collected in May, 1861, by S. B. Buckley, PH!—*Batidophaca cretacea* (Buckl.) Rydb. in N. Amer. Fl. 24: 322. 1929. *A. lotiflorus* var. *cretaceus* (Buckl.) Gates in Trans. Kans. Acad. Sci. 42: 137. 1940.

Astragalus lotiflorus fma. *brachypus* (shortly peduncled) Gray in Proc. Amer. Acad. 6: 209. 1864.—“Both forms are represented in Hall and Harbour’s collection, no. 131.”—Holotypus, GH! isotypus, G!—*A. elatiocarpus* (from *elatiar*, taller and *carpos*, pod, the peduncles supposed to elongate after the fruit is set) Sheld. in Minn. Bot. Stud. 1: 20. 1894, based in large part on the preceding. *A. ammolotus* (sand lotus) Greene in Erythea 3: 76. 1895, a pedantic and illegitimate substitute. *A. lotiflorus* var. *elatiocarpus* (Sheld.) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 244. 1900. *Phaca elatiocarpa* (Sheld.) Rydb. in Bull. Torr. Club 32: 665. 1905. *Cystopora elatiocarpa* (Sheld.) Lunell in Amer. Midl. Nat. 4: 428. 1916.

Astragalus Reverchoni (Julien Reverchon, 1834–1905, collected extensively in Texas from 1856 onward) Gray in Proc. Amer. Acad. 19: 74. 1883.—“... in coll. N. American Plants, distributed by A. H. Curtiss, no. 601.A, supplied by J. Reverchon, from the central parts of Texas ...”—Holotypus, *Reverchon* 8, from n.-w. Texas, collected in 1880, GH! isotypi, 2 sheets, NY!—*Phaca Reverchoni* (Gray) Rydb. ap. Small, Fl. S. E. U. S. 1132. 1903.

Astragalus lotiflorus var. *nebraskensis* (of Nebraska) Bates in Amer. Nat. 29: 670. 1895.—“On June 25, 1892, in the outskirts of Long Pine, Brown Co., Nebraska ... Specimens ... in the herbarium of the Botanical Survey of Nebraska, University of Michigan, and Columbia College.”—Lectotypus, labeled by Bates as “the original find,” NY! isotypus, US!—*A. nebraskensis* (Bates) Bates in Torreya 5: 216. 1905. *Batidophaca nebraskensis* (Bates) Rydb. in N. Amer. Fl. 24: 322. 1929.

Astragalus Batesii (John Mallory Bates, 1846–1930, from 1902 Episcopal minister at Red Cloud, Nebraska, ornithologist and botanist) A. Nels. in Bot. Gaz. 54: 150. 1912.—“[Bates] no. 5501, Red Cloud, Neb., May 17 and May 23, 1911.”—Cotyti, mounted together, RM!

The lotus milk-vetch is a perplexingly variable and polymorphic species. On account of the floral dimorphism, the plants within a colony have actually or potentially a dual aspect; and the populations differ from one to the next in length, density, and orientation of the pubescence, in size and color of the developed flower, and in length and outline of the fruit. Rydberg (1929, p. 315) maintained three species defined mainly in terms of pubescence and pod characters, but these are far from being clear-cut entities and their ranges all appear to converge and overlap in Nebraska and adjoining states. Jones (1923, p. 177) described some of the variants of *A. lotiflorus*, but concluded that they were completely confluent and beyond reach of taxonomic delimitation. However it is possible to make out a rough correlation between a northern and western dispersal, long-pilose or occasionally villous herbage, and a relatively short-beaked, ovoid, villous pod (*A. lotiflorus*, sens. str.); representative: *J. Macoun* 10,192 (ND); *Moodie* 250 (NY); *Hitchcock & Muhlick* 11,802 (NY, RSA, WS); *Bush* 199 (NY); *Rydberg* 74 (NY); *Osterhout* 4327 (NY); *Ripley & Barneby* 8316 (CAS, RSA); *Jones* 43 (NY, POM); *Warnock* 5996 (SRSC), showing a range from Alberta to western Texas; and to contrast this with a southeastern pattern of dispersal, a vesture of shorter, subappressed hairs, and a long, distally acuminate, strigulose fruit (var. *Reverchoni*); representative: *Cory* 55,605 (SMU, WS); *E. Hall* 150 (NY); *Reverchon* (from Sweetwater, Texas) in 1882 (NY, SMU); *Shinners* 9712, 12,180, 12,380 (SMU); *Waterfall* 5948 (OKLA); *G. W. Stevens* 145 (OKLA, NY); *Ripley & Barneby* 8282 (CAS, RSA), 10,567 (RSA); *Eggleston* 20,095 (NY), the characteristic Texan and Oklahoman plant. In the first category cleistogamy is very common, developed flowers being almost unknown on the higher prairies and in the Rocky Mountain foothills, whereas in Texas and Oklahoma the pedunculate inflorescence is the normal one and cleistogamy occurs only rarely, mostly in seedling plants. The following key, prepared during the preliminary studies of *Lotiflori*, presents an idealized view of the possibilities of recognizing two named varieties in the species:

1. Hairs of the herbage mostly straight, appressed or ascending at a narrow angle, up to 0.5–1.1 (a few sometimes to 1.5) mm. long; *pod* mostly over 2 cm. and up to 3.7 cm. long, commonly acuminate distally, strigulose, often silky-canescens in youth; centr. Texas and Oklahoma n.-ward (becoming rarer) to Minnesota and South Dakota = var. *Reverchoni* (including *Phaca cretacea* and *A. Batesii*).
1. Hairs of the herbage either straight and loosely spreading to widely ascending, or spreading and sinuous, mostly up to 1.2–2.2 (2.5) mm. long; *pod* 1.2–2.7 cm. long, more shortly beaked, villous or villous-hirsute; s. Canada to trans-Pecos Texas, w. to Montana, Wyoming, and Colorado, passing e. and s.e. into the last = var. *lotiflorus* (including *A. elatiocarpus*, p. p., and var. *nebraskensis*, a variant with particularly long and loose pubescence).

Near the northwest and southeast limits of the range of *A. lotiflorus*, all plants encountered are likely to satisfy the conditions set up in the key, but unfortunately this is not so elsewhere. In the upper Mississippi Valley and adjoining states the majority of plants are intermediate in either one or all differential characters. Furthermore there are instances of one feature appearing geographically isolated deep in the wrong territory, e.g., *A. & G. Heller 3768* (ND, NY) from Rio Arriba County, New Mexico, which combines in the cleistogamous phase the type of vesture to be expected at the west limit of the species with the long fruit characteristic of var. *Reverchoni* on the low southeastern prairies. Occasionally, also, specimens technically referable to both varieties have been collected in the same place and distributed under one number (e. g., *G. W. Stevens 3050*, OKLA). The evidence before me justifies Jones's treatment of *A. lotiflorus* as a polymorphic but, in practice, indivisible entity.

From the much greater frequency of normally developed racemes in Texas and Oklahoma it seems fair to assume that the so-called var. *Reverchoni* represents the primitive state of the lotus milk-vetch. It is a modest, pretty astragalus, easily recognized by the combination of dolabriform vesture with a tufted habit of growth, free stipules, and campanulate calyx-tube. In its area of dispersal *A. missouriensis* alone is like it in pubescence and habit, differing in the much larger, proportionately narrower flower. Southward, the petals vary from whitish through increasingly vivid shades of lavender into a lively purple, the depth of color seemingly becoming accentuated on calcareous or gypseous soils. The common northern phase of the species is cleistogamous and forms an inconspicuous tuft of pinnate foliage, to the casual glance suggesting some seedling astragalus too young to flower; and it is only close scrutiny which reveals the tiny flowers in the leaf-axils or the subradical clusters of pods huddled close to the ground in the shelter of the leaves. In the rarer chasmogamous individuals which occur northward, the petals vary from whitish to cream-color or pale lilac. Exceptionally both sorts of raceme arise on one plant, as happens also southward, and in them the developed peduncles appear in spring, followed by the cleistogamous type in summer. The causes of cleistogamy are not known, but a long photoperiod may be required. In the southern states, where cleistogamy is rare, established plants reach anthesis soon after the spring equinox; these are followed sometimes by cleistogamous seedlings which flower from seeds germinating the same year. At greater elevations and more northern latitudes, anthesis is delayed until the day is appreciably longer. Occasionally there occurs a type of inflorescence intermediate between the fully cleistogamous and fully developed one; it consists of a short peduncle and about five small pallid, perfectly formed flowers. When Sheldon described *A. elatiocarpus*, he believed that the subobsolete peduncle already described by Gray (as fma. *brachypus*) continued to develop after pollination of the flowers and eventually lifted the ripening pod up to the level of the leaves. Nothing of the sort is known to occur, and Sheldon's term "elatiocarpic" was a needless invention. Although *A. elatiocarpus* was based in part on fma. *brachypus*, the plant actually observed by Sheldon (*No. 5154*, MINN, WIS, from Ottertail County, Minnesota) is an instance of a vernal chasmogamous flowering giving way on the same plant to a later cleistogamous one, both types of inflorescence persisting on a single plant.

The Mexican record of *A. lotiflorus* is based on a single plant of the cleistogamous type collected on a weedy roadside in Carneros Pass south of Saltillo, Coahuila. More collections are required before the species can be considered truly native or even truly established south of the border. For the present *A. lotiflorus* has been omitted from the key to the Mexican species, and the Mexican record left unmapped.

LXXVII. Sectio PANAMINTENSES

Low, shortly caulescent, perennial, with taproot and repeatedly branching caudex beset with wiry persistent petioles; *vesture* basifixed; *leaves* imparipinnate with few (5–11), remote, readily deciduous leaflets; *racemes* loosely few-flowered, the flowers ascending, small (the banner $\pm$ 9.5–14 mm. long), the petals (pink-purple) regularly graduated, the keel-tip obtuse; *pedicels* not thickened, deciduous; *calyx-tube* campanulate; *pod* ascending, sessile, deciduous from the receptacle, small, oblong-ellipsoid, straight or slightly decurved, obtusely triquetrous, keeled ventrally by the prominent suture, openly sulcate dorsally, semibilocular, the valves papery; *dehiscence* apical and downward through the ventral suture, also tardily basal; *ovules* 12–19.—Sp. 1, xeric chasmophyte, of Death Valley and vicinity, California.

ASTRAGALUS sect. PANAMINTENSES, sect. nov. monotypica affinitatis dubiae, caudice iteratim ramuloso petiolis cum rachi filiformibus flexilibus ornato nidum avis quasi simulanti, foliolis paucis remotis deciduis, floribus paucis adscendentibus, leguminis parvi decidui oblongo-ellipsoidei subtrigoni semibilocularis humi dehiscentis valvulis chartaceis, adspectuque proprio insignes.—Sp. unica: *A. panamintensis* Sheld.

The Panamint milk-vetch is taxonomically isolated, and I have no clue to its affinities except at a vague and generalized level. It was thought by Sheldon to be related to *A. atratus*, and this interpretation was accepted by Jones (1923, p. 183, Pl. 42), Rydberg (1929, p. 396) and Jepson, who went so far as to reduce it (l.c.) to varietal status but later restored it (1936, p. 371) to its due category of species and remarked on its peculiar aspect. While admitting that the pod, detached from the plant, is similar in form and texture to that of *A. atratus* var. *owyheensis* (though semibilocular as in var. *atratus*), I must emphasize its ptioloboid method of falling and insist that the flower is not really like that of any *Atrati* in fine detail. I hesitantly incline to the view that *A. panamintensis* is distantly akin to those highly modified *Inflati* in which the pod is little or not at all swollen and at the same time septiferous within. No closer affinity is apparent, and the species is introduced in this place for lack of one obviously better.

306. ASTRAGALUS PANAMINTENSIS

Low, slender, tufted or loosely matted, caulescent or in the first season subcaulescent perennial, with a taproot and intricately forking caudex with pliant branches up to 1–15 cm. long beset with a loose thatch of wiry-filiform, persistent petioles, silvery-canescens nearly throughout with fine, appressed hairs up to 0.25–0.45 mm. long, the leaflets about equally pubescent on both sides; *stems* of the year 1–5 cm. long, composed of several developed internodes up to 1 (2) cm. long but mostly shorter; *stipules* herbaceous becoming papery, with prominent midrib, deltoid or lance-acuminate, 1–3 (4) mm. long, the lowest decurrent around half or more of the stem, free, the upper less so, all more thinly hairy dorsally (sometimes with black hairs) than the canescens stem; *leaves* (1.5) 2–12 cm. long, slender-petioled, with 5–9 (11) distant, linear-elliptic, acute and mucronulate, flat or folded, dorsally keeled, caducous leaflets 2–12 (14) mm. long; *peduncles* ascending, subfiliform, (0.5) 1–6 cm. long, mostly much shorter than the leaf; *racemes* very loosely 1–4-flowered, the flowers ascending, the axis (0) 1.5–3.5 cm. long in fruit; *bracts* ovate or lanceolate, 0.8–2 mm. long; *pedicels* at anthesis 0.8–2 mm. long, in fruit ascending, more or less contorted, not thickened, 1–2.5 mm. long, finally disjoining; *bracteoles* 0; *calyx* 4.6–8.5 mm. long, densely white- and sometimes partly black-strigulose, the subsymmetric disc 0.7–1.3 mm. deep, the rather narrowly campanulate tube (2.7) 3–4.3 mm. long, (1.7) 1.9–2.8 mm. in diameter, the lance- or linear-subulate teeth 1.5–4.4 mm. long; *petals* pink-purple with pale claws; *banner* recurved through $\pm 45^\circ$, 8.2–14 mm. long, the cuneate claw expanded into an ovate-elliptic, notched blade 4.8–7 mm. long; *wings* 7.1–11.1 mm. long, the claws 2.8–4.6 mm., the narrowly oblong or oblanceolate, obtuse, nearly straight blades 4.8–7.5 mm. long, 1.4–2.6 mm. wide; *keel* 6.6–8.7 mm. long, the claws 3–5 mm., the half-obovate blades 3.4–5 mm. long, 2–2.3 mm. wide, abruptly incurved through $90-95^\circ$ to the bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* spreading or ascending (commonly humistrate), sessile, oblong-elliptic or -oblanceolate in profile, a trifle decurved or almost straight, 8–18 mm. long, (2.3) 3.4–4.7 mm. in diameter, contracted distally into a shortly deltoid, laterally compressed beak, otherwise obtusely trigonous, keeled ventrally by the prominent suture, openly sulcate dorsally, the lateral angles rounded, the thin, pale green but purple-speckled, densely strigulose valves becoming papery, stramineous, faintly reticulate, inflexed through the pod's lower $\frac{1}{2}$ or $\frac{2}{3}$ as an incomplete septum 0.7–1.3 mm. wide; *seeds* orange-brown, smooth or sparsely pitted, scarcely lustrous, 1.8–2.4 mm. long.—Collections: 8 (i); representative: Jones (from Panamint Canyon) in 1897 (CAS,

NY, POM); *J. T. Howell* 4006 (CAS); *Alexander & Kellogg* 2662 (NY), 2806 (UC); *Munz* 20,573 (NY); *Ripley & Barneby* 2958 (RSA).

Forming mats on ledges and in fissures of dry limestone cliffs, sometimes seeding down but apparently not persisting on stony canyon bottoms, 4000–7100 feet, with piñon and juniper, rare and local, known only from the Panamint, Last Chance, and Inyo Mountains, Inyo County, California.—Map No. 96.—April to June.

ASTRAGALUS PANAMINTENSIS (of the Panamint Mountains) Sheld. ap. Cov. in Contrib. U. S. Nat. Herb. 4 (Death Valley Rep.): 87. 1893.—“... No. 606, Death Valley Expedition; collected April 13, 1891, in Surprise Canyon, Panamint Mountains, Inyo County, California, by Frederick V. Coville.”—Holotypus, *Coville & Funston* 606, US (2 sheets)! isotypi, DS, GH, K, MINN, NY, UC!—*A. atratus* var. *panamintensis* (Sheld.) Jeps., Man. Calif. 575. 1925. *Tium panamintense* (Sheld.) Rydb. in N. Amer. Fl. 24: 396. 1929.

The Panamint milk-vetch is an altogether remarkable little plant, notable for its repeatedly forking caudex, many slender, incurved branches which are beset with wiry, flexible, marcescent petioles, ultimately forming an involved mass not unlike an untidy bird's-nest. From the tips of the caudex-branches arise the young shoots which bear a few leaves composed of some two to four distant pairs of narrow, pointed leaflets; these dry up and disjoint from the rachis at about the same time as the fruit reaches full maturity. The pod is small, somewhat obliquely and narrowly oblong-ellipsoid, bluntly triquetrous with ventral suture prominent and dorsal face shallowly excavated. Both pedicels and pods disjoint in age, but the pod often becomes caught in the tangled caudex and there dehisces apically at first, then downward through the ventral suture, and finally at base. In the station known to me, below Aguerreberry Point in the Panamint Mountains, *A. panamintensis* is confined to crevices and ledges of almost vertical limestone cliffs, where it is associated with the endemic *Tetracoccus ilicifolius* Cov. & Gilm. From all the reports I have, the habitat is characteristic of the species.

LXXVIII. Sectio HUMILLIMI

Low or diminutive, matted, tufted, or pulvinate perennials, acaulescent or nearly so; *vesture* either dolabriform or basifixed; *stipules* amplexicaul but free; *leaves* imparipinnate, the (3) 5–21 leaflets sessile but disjoining; *racemes* either headlike or loosely few-flowered; *pedicels* not or scarcely thickened, disjoining in age; *flowers* small, the banner 5.5–11.5 mm. long; *calyx-tube* campanulate or subcylindric; *petals* purple, lilac, or reddish, the banner recurved through 45–50°, the wings nearly as long, the obtuse keel much shorter; *pod* spreading or ascending, sessile, deciduous (sometimes tardily) from the receptacle, small (less than 1 cm. long), unilocular, subglobose to ovoid, either subtrigonal or somewhat laterally compressed, keeled ventrally by the prominent, convexly arched suture, contracted at apex into a minute, declined beak, the thinly fleshy valves becoming papery or subcoriaceous; *dehiscence* apical and downward through the ventral or both sutures; *ovules* 4–12.—Spp. 5, xerophytes, of west and central New Mexico, northern Arizona, and extreme southwestern Colorado.

ASTRAGALUS sect. *HUMILLIMI* (Jones), stat. nov., based on *Astragalus* sect. *Homalobi* subsect. *Humillimi* Jones, Rev. Astrag. 68, in clave. 1923.—Sp. typica: *A. humillimus* Gray.

The five species of sect. *Humillimi* are strongly characterized and virtually monomorphic. None is widely dispersed and three of them are known from only one station. Each seems to be highly modified after its own fashion, but the number of characters common to two or more of them leads me to believe the section is a natural group, one that has probably reached a terminal and static evolutionary stage. The affinities of sect. *Humillimi* are obscure and open to discussion; it is introduced here for lack of an obviously more suitable place. Jones (1923) placed *A. gilensis* and *A. humillimus* (largely our *A. cremnophylax*) together in a subgroup of his large sect. *Homalobi*; and although he had perceived and mentioned its manifest affinity to *A. gilensis*, he assigned *A. troglodytus* to the otherwise seleniferous sect. *Ocreati*, some hundred and fifty pages distant in his monograph. Rydberg (1929) associated *A. gilensis* with *A.*

humistratus in *Batidophaca* and followed Jones by disposing of *A. troglodytus* in *Cnemidophacos*. On account of a superficial similarity in the thatch of stiff, marcescent petioles, Rydberg associated the genuine *A. humillimus* with *A. jejunos* in a separate section of *Phaca* designed to accommodate just these two species. The sect. *Humillimi* as defined in these pages differs importantly from sects. *Sericoleuci*, *Humistrati*, *Ocreati*, and *Jejuni* in its free stipules; and further from the first in its deciduous pod, from the second and third in its acaulescent growth-habit, and from the last in its uninflated pod of firm texture. Although the legume varies in compression from one species to another, it is always keeled ventrally by the prominent, convexly arched suture, which runs out into a minute, declined beak. For the present the sect. *Humillimi* is interpreted as an offshoot of the great "piptoloboid" complex of North American *Astragali*, closest perhaps to sect. *Lotiflori* and hence not far removed from sect. *Argophylli*. The latter section contains one species, *A. accumbens*, with campanulate calyx-tube and small flowers, which is difficult to exclude from sect. *Humillimi* except on the grounds that its pod fails to disjoin upon ripening. The presumed origin of *A. accumbens* by mutation from the greatly different *A. missouriensis* is argued elsewhere. Very possibly the *Humillimi* are to be traced back to a similar source.

Key to the Subsections of Sect. Humillimi

1. Pubescence basifixed, the herbage pilose with ascending hairs up to 1–2 mm. long, the inflorescence and pod hirsute; *calyx-tube* deeply campanulate, distended by the forming pod; *petals* dull reddish LXXVIII (i). Subsect. *Troglodyti*
1. Pubescence dolabriform, the straight, truly or loosely appressed hairs mostly less than 1 mm. long, the pod strigulose; *calyx-tube* shortly campanulate, not accrescent after anthesis; *petals* pale- or purple-pink LXXVIII (ii). Subsect. *Humillimi*

LXXVIII (i). Subsectio TROGLODYTI

Vesture basifixed, the herbage silky-pilose with subappressed and ascending hairs, the inflorescence and pod hirsute; *calyx-tube* deeply campanulate, distended (but ultimately ruptured) by the tumescent ovary and together with the marcescent petals partially investing the ripe fruit; *petals* dull reddish-purple.—Sp. 1, of northcentral Arizona.

ASTRAGALUS sect. HUMILLIMI subsect. TROGLODYTI, subsect. nov., ab *Humillimis* genuinis pube basifixa, inflorescentia hirsuta, calycis tubo ad anthesin profundius campanulato dein accrescenti, petalisque rubro-vinaceis sejuncti. Habitus *A. gilensis* est ob inflorescentiam longe pedunculatam plurifloram fructiferam valde densam.—Sp. unica: *A. troglodytus* Wats.

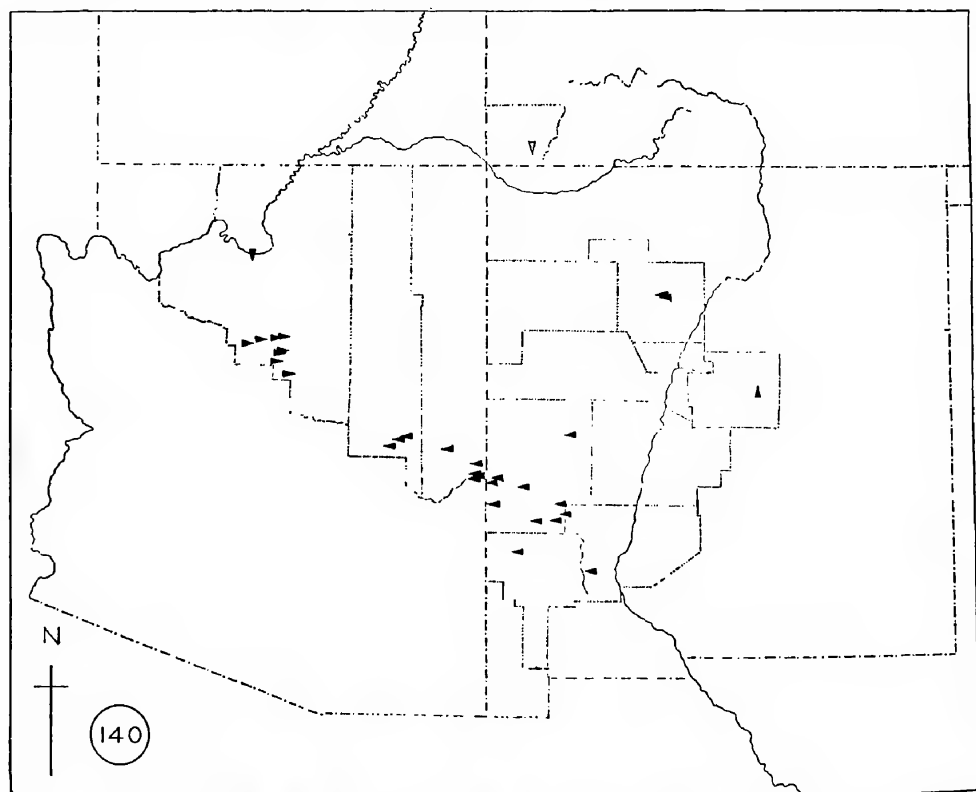
307. ASTRAGALUS TROGLODYTUS

Acaulescent or nearly so, with a tough, woody taproot and shortly forking caudex or knotty root-crown, the herbage green or gray-green beneath the pilose vesture, the leaflets glabrous or medially glabrescent above; *stipules* papery-membranous, several-nerved, 3–11 mm. long, semi- or fully amplexicaul but free, the lowest ovate and glabrous, the upper triangular-acuminate or broadly lanceolate, pilose or glabrescent dorsally, ciliate; *leaves* 3.5–11.5 cm. long, slender-petiolate, with (7) 11–19 obovate, obovate-cunate, rhombic, or broadly oblanceolate, subacute, obtuse and mucronulate, or rarely obtuse, flat or loosely folded leaflets 4–13 mm. long; *peduncles* scapiform, 4.5–13 cm. long, incurved-ascending at anthesis, straight, prostrate, radiating in fruit; *racemes* densely 10–30-flowered, the spreading and ascending flowers forming a globose or oval, headlike cluster 1.5–2.5 cm. in diameter; *bracts* submembranous, linear-lanceolate, 3–8.5 mm. long, at least the lowest ones reflexed; *pedicels* at anthesis 0.4–0.8 mm., in fruit not over 1 mm. long; *bracteoles* 0–2, setaceous when present; *calyx* 5.9–8.2 mm. long, thinly hirsute with lustrous, divaricate, and ascending hairs up to 1.1–1.8 mm. long, the obconic disc 0.6–1.2 mm. deep, the tube at anthesis deeply campanulate, 3.4–5.2 mm. long, 2.3–2.9 mm. in diameter, the linear-lanceolate or setaceous teeth 1.9–3 mm. long, the tube becoming membranous, at first distended by the forming pod, ultimately ruptured, marcescent; *petals* dull reddish-purple, marcescent; *banner* recurved through about 45°, 9.5–11.4 mm. long, the cuneately tap-

ering claw expanded into an oval-ovate, retuse or subentire blade 4.2–6.3 mm. wide; wings (a trifle shorter to 0.5 mm. longer than the banner) 9.2–11.2 mm. long, the claws 4.3–5.6 mm., the narrowly oblong, obtuse, gently and equally incurved blades 5.5–6.8 mm. long, 1.6–2.1 mm. wide; keel 7.9–9.1 mm. long, the claws 4.1–5.6 mm., the lunately half-oval or -obovate blades 3.3–4.1 mm. long, 1.9–2.5 mm. wide, incurved through $\pm 100^\circ$ to the blunt apex; anthers (0.35) 0.4–0.55 mm. long; pods spreading and ascending in oblong or globose, headlike clusters, plumply ovoid or subglobose, 5–7 mm. long, 4–4.5 mm. in diameter, rounded at base, abruptly contracted distally into a triangular, cuspidate, declined beak 0.8–1.5 mm. long, somewhat turgid, terete or a trifle compressed laterally, carinate ventrally by the thick suture, the thinly fleshy, green or purple-tinged, sparsely long-hirsute valves becoming firmly papery, stramineous or brownish, rugulose-reticulate; ovules 8–12; seeds (not seen fully ripe) ± 1.5 –1.8 mm. long.—Collections: 18 (iii); representative: A. & R. Nelson 2094 (NY, RM); Loomis 6927 (ARIZ, NY); Deaver 1147 (CAS, NY), 2824 (CAS); Ripley & Barneby 4897 (CAS, RSA).

Dry slopes and flats in yellow pine forest, in poor stony soil derived from scoriae and rotted pine needles, 6500–7000 feet, very local, Flagstaff Plateau and adjacent Mogollon Rim, Coconino County, Arizona.—Map No. 140.—May to August.

ASTRAGALUS TROGLODYTUS (cave dweller, from the type-locality) Wats. in Proc. Amer. Acad. 20: 362. 1885.—“In the San Francisco Mountains, Arizona, near the ‘Cliff-dwellers’ Ravine,” Mr. and Mrs. J. G. Lemmon, August, 1884.”—Holotypus, Lemmon 3225, GH!—*Cnemidophacos troglodytus* (Wats.) Rydb. in N. Amer. Fl. 24: 288. 1929.



Map No. 140. Arizona, New Mexico, and parts of Utah and Colorado. Range of ◆ *A. troglodytus*; of ◈ *A. gilensis*; of ▲ *A. siliceus*; of ■ *A. cremnophylax*; and of ◇ *A. humillimus*.

In the sum of its peculiar technical characters the cliff-dwellers' milk-vetch, *A. troglodytus*, stands apart as one of those detached, highly distinctive monotypes in which the genus is so rich. However its general habit of growth, its large, imbricated stipules, and especially the form and arrangement of the small pods in dense, humistrate heads express its near kinship with *A. gilensis*. These two species are found in almost identical environments in the Mogollon pine forests and are vicariant in distribution. Around Flagstaff *A. troglodytus* is sometimes associated with the subcaulescent *A. castaneiformis*, which is easily distinguished by its dolabriform vestiture, longer and narrower flowers of a pallidly lilacine or luridly purplish hue, and much larger pods arranged in loose, short racemes of ten or less. No other North American *Astragalus* has flowers of quite the same reddish-purple tint that I have seen in *A. troglodytus*. Unfortunately the color fades rapidly in most pressed specimens.

The cliff-dwellers' milk-vetch has been reported (Kearney & Peebles, 1951, p. 458) to extend north to the Kaibab Plateau, but this is probably a mistake. Specimens so labeled by Dr. Kearney have turned out to be the superficially similar *Oxytropis oreophila* Gray.

LXXVIII (ii). Subsectio HUMILLIMI

Vestiture dolabriform, dense, the herbage and inflorescence silvery- or ashen-strigulose; *calyx-tube* shortly campanulate, unchanged in fruit; *petals* pale or purplish-pink, the wings white-tipped.—Spp. 4, with range of the section.

Key to the Species of Subsect. Humillimi

1. Plants simply tufted, the leaves 2–9 cm. long, the 11–25 leaflets 3–12 mm. long; *peduncles* subscapose, 2.5–15 cm. long; *racemes* densely 7–26-flowered 308. *A. gilensis*
1. Plants matted, pulvinate, or densely prickly-tufted, the leaves 0.3–3 cm. long, the 5–11 (13) leaflets 1–5 mm. long; *peduncles* axillary, 2–6 (11) mm. long; *racemes* 1–3-flowered (2)
2. Leaf-rachis flaccid, persisting (if at all) as soft tatter-like remnants on the root-crown or caudex-branches; centr. New Mexico or Grand Canyon, Arizona (3)
3. Flowers relatively large, the banner 9.5–11.5 mm., the keel at least 7.5 mm. long; *pod* 5–7.5 mm. long, laterally compressed; *ovules* 8–10; centr. New Mexico 309. *A. siliceus*
3. Flowers very small, the banner $\pm$ 5–6 mm., the keel not over 4.5 mm. long; *pod* 3–4.5 mm. long, flattened or basally depressed dorsally; *ovules* 4–6; Grand Canyon, Arizona 310. *A. cremnophylax*
2. Leaf-rachis stiff, persisting on the caudex-branches in the form of rigid tragacanthoid (but hardly vulnerant) spines. Flowers and ovules apparently as in *A. cremnophylax*, but the small pod laterally compressed; Mesa Verde, s.-w. Colorado 311. *A. humillimus*

308. ASTRAGALUS GILENSIS

Acaulescent or nearly so, the leaves tufted on a multicapital root-crown or shortly forking caudex beset with a thatch of marcescent, closely imbricated, brownish stipules, the herbage silvery-strigulose (strigose) with appressed and often a few narrowly ascending hairs up to 0.5–1.1 mm. long, the leaflets equally pubescent on both sides; *stipules* submembranous becoming papery, 4–9 mm. long, the erect, ovate or broadly lanceolate blades densely pubescent dorsally; *leaves* (1.5) 2.5–9 cm. long, with slender petioles and (7) 11–21 (25) elliptic, oblong-elliptic, or oblanceolate and acute, more rarely oval-elliptic and obtuse or emarginate, flat or loosely tufted leaflets (2) 3–12 mm. long; *peduncles* (2.5) 3.5–15 cm. long, mostly surpassing the leaves, at anthesis incurved-ascending, arcuate-reclinate or prostrate and radiating in fruit; *racemes* densely 7–26-flowered, the upper flowers ascending, the lower ones spreading or declined, together forming a subcapitate cluster or oblong-ovoid head, the axis scarcely elongating, 0.5–2.5 cm. long in fruit; *bracts* submembranous, lanceolate, 1.5–4 mm. long; *pedicels* either straight and ascending or a little arched outward, 0.6–1.5 mm. long, a trifle thickened but scarcely longer in fruit; *bracteoles* 0–2; *calyx* 3.7–6 mm. long, strigulose with white or mixed black and white hairs, the slightly oblique disc 0.4–0.9 mm. deep, the tube 2.3–4 mm. long, 1.6–2.4 mm. in diameter, the erect, subulate

teeth 1.3–2.7 mm. long, the whole becoming papery, ruptured, marcescent; *petals* varying from flesh-pink to pink-purple with white wing-tips; *banner* recurved through 45–50°, elliptic or elliptic-oblongate, shallowly notched, 6.2–10.4 mm. long, (2.8) 3–5.6 mm. wide; *wings* 5.8–9 mm. long, the claws 2.1–3.9 mm., the oblong-oblongate or elliptic, obtuse or emarginate blades (3.7) 4–6.2 mm. long, 1.4–2.7 mm. wide, both incurved but the left more strongly so and its inner margin infolded; *keel* 4.3–6.8 mm. long, the claws 2.2–3.6 mm., the half-circular or -obovate blades 2.5–3.6 mm. long, 1.5–2.2 mm. wide, abruptly incurved through 95–120° to the blunt, deltoid, sometimes minutely porrect apex; *anthers* 0.3–0.5 (0.55) mm. long; *Pods* ascending or spreading according to their position in the crowded, globose or oblong fruiting head, obliquely ovoid or oblong-ellipsoid, 4.5–7.5 mm. long, 2–4.2 mm. in diameter, rounded or shortly obconic at base, abruptly contracted distally into a declined, cusplike beak 0.5–1.2 mm. long, keeled ventrally by the thick, prominent, convexly arched suture, at once obscurely trigonous and a trifle laterally compressed, the convex lateral faces wider than the flattened or shallowly grooved dorsal one, the decidedly fleshy and firm, reddish-tinged, strigulose valves becoming brownish, stiffly papery or almost leathery, faintly cross-reticulate; *ovules* 7–11, commonly 8; *seeds* ocher, purplish-brown, or brown blotched with purple, obscurely pitted or smooth but scarcely lustrous, 1.4–2 mm. long.—Collections: 22 (vi); representative: *Metcalfe* 1553 (CAS, NY, NMC); *Barneby* 12,615 (CAS, RSA); *Eggleston* 20,255, 20,274 (NY); *Ripley & Barneby* 5094 (RSA).

Dry sandy or gravelly flats, knolls and benches in xeric pine forest, 5600–8600 feet, locally plentiful in scattered stations in the Mogollon mountain system about the headwaters of the Little Colorado and Gila Rivers, from southern Navajo County, Arizona, southeast to western Sierra and northern Grant Counties, New Mexico; apparently somewhat isolated to the northeast on the Jemez Mountains, Sandoval County, New Mexico.—Map No. 140.—(April) May to September.

ASTRAGALUS GILENSIS (of Gila River) Greene in Bull. Torr. Club 8: 97. 1881 ("*Gilensis*").—"On a high summit at the mouth of the canyon of the Gila River. April, 1881."—Holotypus, labeled in Greene's hand and with additional datum in pencil: "*No. 1553*," but without date or locality, ND (*Herb. Greene. No. 31,089*)! isotypi, collected April 3, 1881, CAS, GH, MO!—The Greene spms. at K, dated April 30, and ex herb. Porter. at PH, although dated 1880, are probably other isotypi.—*Batidophaca gilensis* (Greene) Rydb. in N. Amer. Fl. 24: 318. 1929.

The Gila milk-vetch is a sharply defined and stable species, its silvery dolabriform vesture, slender, relatively long, scapose peduncles bearing dense heads of pinkish or purple and white flowers, and its small, crowded pods of characteristic form and compression all contributing to an idiosyncratic facies. The species most like it in general organization and habit of growth is the related *A. troglodytus*, but this is readily distinguished by its hirsute inflorescence and pod and its larger, reddish-purple flower. The species has been collected in flower and fruit in every month from April to September. In cultivation it has flowered continuously through the summer, but in its natural habitat the period of abundant flower usually follows summer rains and the spring crop of fruits is small and uncertain.

309. *ASTRAGALUS SILICEUS*

Subcaulescent, densely pulvinate, the ultimate divisions of the repeatedly forking, suffruticulose caudex becoming columnar from the thatch of scaly marcescent stipules and fibrous leaf-bases, the very numerous, tightly packed leaf-rosettes forming low-convex mounds 1–3 dm. in diameter, the herbage silvery-strigulose with appressed and subappressed, mostly straight hairs up to 0.6–0.9 mm. long; *stems* of the year almost 0, rarely up to 1 cm. long, wholly concealed by stipules; *stipules* submembranous becoming pallid and papery, ovate or lanceolate, 1.5–3 mm. long, embracing ½–⅓ the stem's circumference; *leaves* 0.5–3

cm. long, slender-petioled, with (3) 5–9 crowded, elliptic, oblanceolate, or (on some short, early leaves) obovate, obtuse or subacute, loosely folded leaflets 1.5–5 mm. long; *peduncles* very slender, ascending, 1.5–6 (11) mm. long, much shorter than the leaves; *racemes* loosely 1–3 (commonly 2)-flowered, the flowers ascending, the axis (produced as a subulate appendage beyond the last flower) 1–3 (4) mm. long; *bracts* membranous, ovate or broadly lanceolate, 0.7–2.2 mm. long; *pedicels* 2.2–3.5 mm. long, flexuously ascending or at length somewhat arched outward, scarcely elongating or thickened in fruit; *bracteoles* 0; *calyx* 4–5.9 mm. long, silky-strigulose with white hairs, the subsymmetric disc (0.6) 0.8–1.1 mm. deep, the campanulate tube 3.2–4.2 mm. long, 1.9–2.5 mm. in diameter, the subulate teeth 0.8–1.8 mm. long; *petals* pink-purple, drying bluish, the wing-tips whitish, the banner purple-penciled in the fold; *banner* spatulate-oblanceolate or obovate above the long-cuneate claw, deeply and openly notched, 9.5–11.5 mm. long, 5–7 mm. wide; *wings* 9.4–11 mm. long, the claws 4–4.7 mm., the narrowly elliptic or elliptic-oblanceolate, obtuse or obscurely emarginate blades 4.9–7 mm. long, 1.6–2.2 mm. wide, both nearly straight and erect; *keel* 7.5–8.7 mm. long, the claws 4.1–4.9 mm., the half-obovate blades 3.6–4.5 mm. long, 1.6–2.1 mm. wide, abruptly incurved through 90° to the blunt apex; *anthers* (0.4) 0.45–0.6 mm. long; *pod* ascending or spreading, obliquely ovoid, 5–7.5 mm. long, 2.8–3.8 mm. in diameter, rounded at base, abruptly contracted distally into a short, declined (rarely suberect) cusp, laterally compressed and bicarinate by the sutures, but the ventral suture thicker, more prominent, and more strongly convex than the dorsal one, the faces low-convex, the green, thinly fleshy, densely strigulose valves becoming stiffly papery; *ovules* 8–10; *seeds* unknown.

Rocky knolls on high rolling plains, in arid grassland, on granite, about 6250 feet, known only from the type-locality on the Pecos-Rio Grande divide in central Torrance County, New Mexico.—Map No. 140.—May to June.

ASTRAGALUS SILICEUS (flinty, of the Pederal or Flint Mountains) Barneby in Leaflet. West. Bot. 8: 14. 1956.—“NEW MEXICO: . . . southerly foothills of the Pederal Mts., 3 miles w. of Negra, Torrance County, 7 May and 22 May, 1955 . . . Barneby 12,600 & 12,816.”—Cotypi, CAS! isotypi GH, K, NY, POM, RM, RSA, US, WS!

The high rolling country that forms the watershed dividing the Pecos from the Rio Grande in central New Mexico is relatively little known botanically. Its flora is of interest to the botanical geographer since it comprises elements of southern and western Texan origin mingling with others derived from the Rocky Mountain piedmont and the higher Great Plains, here at or near the limits of their dispersal; and it is further enriched by a few endemic species. The Flint Mountains milk-vetch is probably to be numbered among the latter, although one must anticipate some extension of its range as exploration of the region progresses.

When past flowering the plants of *A. siliceus* are inconspicuous features of the sparse and low, markedly xerophytic flora of rocky knolls which stand up in isolation out of the sandy clay plains. In the early days of May, however, when the majority of other herbaceous plants are only just beginning to stir from winter dormancy, the silvery-gray mounds of the astragalus are lavishly decked with small, vivid flowers, forming patches of solid color visible from afar. Except for some pulvinate forms of the distantly related, superficially similar *A. spatulatus* and some alpine populations of *A. Kentrophyta* var. *implexus*, there is no more brilliant cushion astragalus in North America. In the context of its section *A. siliceus* seems to form a link between *A. gilensis*, of which it has the comparatively large flower and numerous ovules, and the two species following, similar in their depressed habit of growth, few-flowered racemes, and few small leaflets. In the laterally compressed pod it is nearest to *A. humillimus*, although very different in other respects.

310. *ASTRAGALUS CREMNOPHYLAX*

Diminutive, matted or somewhat mounded, essentially acaulescent but suffruticulose, with a gnarled, closely ramifying caudex, the ultimate divisions becoming columnar from a sand-impacted thatch of fibrous, decaying leaf-bases, the

herbage silvery-strigulose with truly appressed, straight hairs up to 0.3–0.35 mm. long, mature plants forming low-convex cushions up to 2 dm. in diameter; *stems* of the year not over 5 mm. long, concealed by imbricated stipules; *stipules* deltoid-ovate, subobtuse, 1–3 mm. long, fully amplexicaul but free, the nearly glabrous or distally puberulent blades squarrose, becoming papery and brownish in age; *leaves* 3–9 (12) mm. long, with (3) 5–9 crowded, sometimes subpalmate, elliptic, obovate, or suborbicular, obtuse, thick-textured, folded leaflets 1–2.5 mm. long; *peduncles* subfiliform, up to 5 mm. long, reclinate in fruit; *racemes* 1–3 (commonly 2)-flowered, the flowers loosely ascending, the fruiting axis not over 2 mm. long; *bracts* membranous, ovate, 0.6–1 mm. long; *pedicels* ascending, nearly straight, at anthesis about 0.7 mm., in fruit about 1 mm. long; *bracteoles* 0; *calyx* 2.7–3.5 mm. long, strigulose with mixed black and white hairs, the subsymmetric disc 0.3–0.4 mm. deep, the campanulate tube 1.7–2.3 mm. long, 1.5–1.7 mm. in diameter, the subulate, obtuse teeth 0.8–1.4 mm. long; *petals* pale pinkish-lilac, the wings white-tipped, the banner purple-veined, the keel-tip maculate; *banner* recurved through 45°, broadly ovate- or suborbicular-cuneate, shallowly notched, 5.3–6.1 mm. long, 4.3–4.6 mm. wide; *wings* as long or a trifle shorter, the claws 1.9–2.1 mm., the ovate-elliptic, obtuse blades 3.5–4.4 mm. long, 1.6–2 mm. wide, both incurved but the left one more strongly so and its inner margin infolded; *keel* 3.7–4.3 mm. long, the claws 1.7–2 mm., the half-obovate or nearly half-orbicular blades 2–2.8 mm. long, 1.3–1.7 mm. wide, abruptly incurved through 100–120° to the bluntly deltoid, minutely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* ascending (mostly humistrate), obliquely ovoid, 3–4 (4.5) mm. long, about 2.5 mm. in diameter, rounded at base, flattened or slightly depressed dorsally, carinate ventrally by the prominent, thick, convexly arched suture, contracted distally into a minute, declined, deltoid beak, the thinly fleshy, pale green or purple-dotted, densely strigulose valves becoming papery and stramineous, obscurely reticulate; *ovules* 4–6; *seeds* amber-yellow or pale orange, smooth or nearly so, dull, 1.4–1.8 mm. long.—Collections: 3 (i); representative: *Jones* (from El Tovar) in 1903 (CAS, POM, US); *W. J. Dress* 3270 (G).

Crevices of limestone pavement in the piñon belt, about 7050 feet, known only from one colony of plants on the South Rim of the Grand Canyon of the Colorado River, near El Tovar, Coconino County, Arizona.—Map No. 140.—May to early June.

ASTRAGALUS CREMNOPHYLAX (from *cremnos*, gorge, and *phylax*, watchman, from the dramatic habitat) Barneby in Leaflet West. Bot. 5: 83. 1848.—“ARIZONA: . . . on the south rim of the Grand Canyon . . . west of El Tovar, Coconino Co. . . 3 June, 1947, Ripley & Barneby 8473.”—Holotypus, CAS! isotypi, GH, NY, RSA, UTC!

Evolutionary convergence of distantly related groups of plants from a commonplace herbaceous or suffrutescent type into the mounded or densely matted growth-form of the polsterpflanz, so highly developed in the Andes, in Patagonia, and to less extent in North America, is well illustrated by the sentry milk-vetch, *A. cremnophylax*, and the preceding species, *A. siliceus*, when compared with the superficially similar cushion astragali here referred to sects. *Sericoleuci*, *Drabellae*, and *Ervoidei*. The pulvinate *Humillimi* appear to be derived from *A. gilensis*, or from a similar and recent common ancestor, and have retained nearly all basic features of flower, fruit, stipule, and hair-attachment; but by reduction of nearly all organs either in size or number or both, in response to different but similar sets of ecological pressures and favorable circumstances, they have come to resemble species of widely differing ancestry. In practice *A. cremnophylax* should be easily recognized, although one must be careful to distinguish the reduced small-leaved form of *A. calycosus*, readily identified by its larger flower with bidentate wings and oblong, compressed, bilocular pod, the one other (and much commoner) dwarf, silvery astragalus found along the Canyon rim.

The sentry milk-vetch is one of our rarest species. It was first discovered in 1903 by Marcus Jones, who mistook it for *A. humillimus* and reported it (1923, p. 82, Pl. 6, fig. 19) as “apparently common at the Grand Canyon . . . on sandy ledges.” Search in recent years has

revealed, however, only a single group of perhaps a hundred plants confined to a strip of rock pavement not over fifty yards in length. They are scattered over the area, some in full sun and rooting in scarcely visible cracks of the limestone, others standing back among the piñons and rooting into sand-filled hollows of the rock. It is to be sought elsewhere in the region, perhaps on some of the buttes which stand out in isolation from the canyon wall.

311. ASTRAGALUS HUMILLIMUS

Diminutive, tufted perennial, cinereously strigulose with straight, truly appressed, largely dolabriform hairs up to 0.2–0.3 mm. long, the leaflets pubescent on both sides, the closely and repeatedly forking, suffruticulose caudex beset with scaly persistent stipules and rigid, subspinescent petioles; *stems* of the year $\pm$ 0.5–1 cm. long, the internodes very short, concealed by imbricated stipules; *stipules* submembranous, becoming papery, deltoid-ovate, 1–1.5 mm. long, fully amplexicaul but free, pubescent dorsally, the tips recurved; *leaves* 8–15 mm. long, shortly petioled, with stiff, subterete, tapering rachis and 7–11 (13) obovate-cuneate or oblong-elliptic, obtuse, sessile but articulate, loosely folded, thick-textured, finally deciduous leaflets 0.7–2 mm. long; *peduncles* 2–4 mm. long; *racemes* very shortly 1–3-flowered; *calyx* $\pm$ 3 mm. long, the tube 2.2 mm., the subulate teeth $\pm$ 0.8 mm. long; petals not seen, “pallid” (ex char., but probably purplish); *pod* apparently spreading, sessile, tardily disjoining from the receptacle, oblong-ellipsoid, $\pm$ 4.5 mm. long, 2 mm. in diameter, carinate by the prominent sutures, the strigulose valves becoming stiffly papery and stramineous; *dehiscence* apical and downward through both sutures; *ovules* apparently 4 (“9” acc. Gray); *seeds* not seen.—Collections: typus only.

Sandstone rock ledges in the piñon belt, sometimes submerged in drifting sand, apparently very rare and local, known only from the type-station on the Mesa Verde, Montezuma County, Colorado.—Map No. 140.—May to July.

ASTRAGALUS HUMILLIMUS (smallest of all) Gray ex Brand. in Bull. U. S. Geol. Surv. 2³: 235. 1876.—“Growing upon sandstone rock of the Mesa Verde, near the edge of Mancos Canyon.”—Holotypus, *Brandeggee* 1087, collected in July, 1875, GH! isotypi, MO, NY, UC, US!—*Tragacantha humillima* (Gray) O. Kze., Rev. Gen. 945. 1891. *Phaca humillima* (Gray) Rydb. in Bull. Torr. Club 32: 665. 1905.

The typus of the singular little Mancos milk-vetch, *A. humillimus*, was collected in high summer when the flowers were past and all but the last fruits had fallen. I have seen only one perfect pod, but this is, as Gray described it, laterally compressed and carinate by both sutures. It is, in fact, like that of the much larger-flowered *A. siliceus*, while that of *A. cremnophylax*, with which *A. humillimus* was confused by Jones (1923, p. 82, Pl. 6), is obtusely trigonous, with a salient ventral keel opposed to a distinctly flattened or even depressed dorsal face. The two species of Grand Canyon and Mesa Verde are otherwise similar, except for the petioles of *A. humillimus* which ripen into stiff, persistent structures quite analogous to the so-called spines that form the armature of the Asiatic tragacanth. In habit of growth *A. humillimus* resembles *A. jejunos*, a species of southern Wyoming in which the caudex is also beset with a thatch of stiffly marcescent petioles. The two species were associated by Rydberg (1929, p. 359) in a section of *Phaca* characterized by this feature, but the stipules of *A. jejunos* are connate and its pod is bladdery and of extremely thin texture. They differ further in the mode of hair-attachment, and the similarity in growth-form is probably fortuitous.

Brandeggee left unusually precise records of the habitat of *A. humillimus*. It should be easy to find again, but it has nevertheless eluded repeated search on Mesa Verde and along the Mancos canyon to the east. It is to be sought in crevices of rimrock pavement and on sand-filled ledges of shelving rock masses, the ecological niches in which several specialized Basin astragali have found a congenial home. Care should be taken to distinguish two other dwarf astragali found in similar places on the Mesa, *A. calycosus* var. *scaposus* and the endemic *A. deterior*. Both have flaccid petioles and longer oblong or narrowly ellipsoid pods, grooved dorsally and partially or fully bilocular.

LXXIX. Sectio LEPTOCARPI

Caulescent annuals, biennials, and perennials (usually of short duration), with superficial root-crown or caudex; *vesture* basifixed or (subsect. *Arizonici*) dolabriform; *leaves* imparipinnate, with 5–27 leaflets; *racemes* loose but often short or subumbellate, 1–30-flowered, the flowers ascending or spreading, often declined in age, small or medium-sized, the banner 4–18.5 mm. long, the axis elongating or not in fruit; *pedicels* persistent; *calyx-tube* campanulate, sometimes deeply so; *petals* (commonly purple or purple-tinged or -tipped, rarely whitish) regularly or irregularly graduated, the keel-tip obtuse or acute; *pod* erect, ascending, spreading to declined and incurved-ascending distally, or (subsect. *Mohavenses*) declined to pendulous, sessile and deciduous or (subsect. *Leptocarpi*, *A. coahuilae*) sessile to short-stipitate and persistent until dehiscence, mostly linear to linear-oblongate or narrowly oblong to lance-oblong in profile, triquetrous or compressed-triquetrous, grooved dorsally, rarely (*A. Breweri*) ellipsoid with long terminal cusp, or (*A. mohavensis*) fleshy and subterete becoming laterally compressed and bicarinate by the sutures, the valves commonly papery, inflexed as a complete or subcomplete (in *A. Nuttallianus* sometimes obsolescent) septum; *dehiscence* apical, and if deciduous also basal, after falling; *ovules* (2) 4–30.—Spp. 24, xerophytes, of southwestern United States and Mexico, but penetrating only feebly north into the Colorado and Great Basins.

With sect. *Leptocarpi* I take up a type of *Astragalus* which is similar in most respects to the *Inflati*, but the pod, instead of being swollen and ordinarily unilocular, is narrow and elongate, trigonously compressed, and divided into two chambers except at apex by a full partition. A pod of this sort, which might be called "hamosoid" on account of its likeness to that of the Old World annual *A. hamosus* L., is found in groups of species native to both hemispheres and as far apart as Mexico and Morocco; it has apparently arisen independently several times and, as in our *A. Lindheimeri*, *A. Breweri*, and *A. mohavensis*, is often subject to further modifications.

The diagnosis of sect. *Leptocarpi* is so drawn in these pages as to include those astragali of southwestern United States and Mexico in which a pod of the hamosoid type coincides with developed stems, free stipules, flowers neither very numerous nor abruptly reflexed, and a calyx-tube shallowly or less often deeply campanulate. It embraces both annual and perennial species, and some of uncertain duration, making a sectional division along these lines impossible to maintain. As defined here the *Leptocarpi* are approximately coextensive with the section of the same name established by Jones, together with a number of species transferred from his *Micranthi* and *Hamosi*; and (disregarding a few misplaced entities) equivalent to *Hamosa* sects. *Tricarinatae*, *Hartwegianae* (in part), *Leptocarpae*, and *Acutirostres* of Rydberg's revision (1927, 1929).

In their adaptation to desert or semidesert climates the majority of *Leptocarpi* have reached a high level of specialization, and it has been found necessary to include a few species in which this has been carried beyond the ideally conceived limits of variation in the section. Thus in *A. mohavensis* the pod has become fleshy and heavy with pulp, hence declined by the force of gravity; and in one form the ultimate mode of compression is lateral and not three-sided. The pod of the genuine subsect. *Leptocarpi* is persistent, and in one species has become truly stipitate. In subsect. *Tricarinati* and in *A. Clarianus* of subsect. *Californici*, the pod is of a hamosoid type but elevated on a gynophore and pseudostipitate. The affinities of these more or less aberrant species are apparent nevertheless through existing close relatives. There remains a residue of *Astragali*, formerly referred to *Hamosa* or equivalent groups in *Astragalus*, which have pods of the same general form but no immediately apparent affinities in sect. *Leptocarpi*. Those most likely to be sought among the *Leptocarpi* are the *Micranthi*, distinguished by their long, narrow racemes of tiny, nodding flowers and abruptly recurved fruits; the *Scaposi*, acaulescent *Astragali* with dolabriform *vesture* and cleft wing-petals; and the peculiar *A. Greggii* in which the stipules low on the stems are connate and the slender stems themselves are hirsute with perpendicular or somewhat retrorse hairs.

The *Leptocarpi* can be divided advantageously into subsidiary groups differing in the hair-attachment, the duration of the root (in doubtful cases a species is keyed under both alternatives), the size and shape of the calyx and petals, and minor carpological characters. These are arranged below, so far as a linear sequence permits, in an order of increasing specialization.

Key to the Subsections of Sect. *Leptocarpus*

1. Plants perennial or biennial, sometimes flowering the first year or even within a few months after the seed's germination but not truly monocarpic (nearly always some aged plants in a given population) (2)
2. Pubescence basifixed (3)
3. Pod readily deciduous from the receptacle; not of s. Coahuila and vicinity, and if approaching this area the leaflets less than 21 and the stems short and diffuse (4)
4. Leaflets 5-11, densely silvery-canescens; *pod* declined or pendulous; Mohave and n. Colorado Deserts, s.-e. California and adjoining Nevada LXXIX (iii). Subsect. *Mohavenses* (p. 1020)
4. Leaflets more numerous, if scarcely so then the upper surface greenish, glabrous or medially glabrescent; *pod* erect or ascending (spreading in *A. Bryantii* of Grand Canyon and extreme s. Utah) (5)
5. Ovary and pod glabrous, the latter subequally 3-sided, elevated on a short gynophore; Mohave and n. Colorado Deserts, California LXXIX (v). Subsect. *Tricarinati* (p. 1029)
5. Ovary and pod pubescent, the pod sessile on the flat or inconsiderably elevated receptacle, mostly compressed-triquetrous, the dorsal side narrowest and grooved, not equally 3-sided (6)
6. Calyx-tube deeply campanulate, $\pm$ 3.5-6 mm. long; *banner* usually over 8.5 mm. long, if shorter then the keel-tip acute LXXIX (i). Subsect. *Pringlei* (p. 1010)
6. Calyx-tube shallowly campanulate, $\pm$ 2.5-3.3 mm. long; *banner* $\pm$ 7-8 mm. long LXXIX (iv). Subsect. *Parvi* (p. 1026)
3. Pod continuous with the receptacle, dehiscent on the raceme; *stems* over 2 dm. long, erect and ascending; *leaflets* 17-27; s. Coahuila and n. Zacatecas LXXIX (vii). Subsect. *Coahuilani* (p. 1055)
2. Pubescence dolabriform; Arizona and adjoining Mexico LXXIX (ii). Subsect. *Arizonici* (p. 1017)
1. Plants annual, germinating either in fall (winter) or spring but truly monocarpic, perishing after flowering (7)
7. Pod deciduous when ripe and dehiscent by both ends on the ground (in the case of flowering material turn to discussion of subsections. *Californici* and *Leptocarpi*) LXXIX (vi). Subsect. *Californici* (p. 1034)
7. Pod persistent until dehiscence LXXIX (viii). Subsect. *Leptocarpi* (p. 1057)

LXXIX (i). Subsectio PRINGLEANI

Biennial and short-lived perennial, sometimes flowering the first spring and then appearing (and perhaps truly) annual; *vesture* basifixed; *leaflets* 7-21; *racemes* 3-20 (25)-flowered, the flowers ascending or spreading in age, of moderate size, the *banner* 8-16 mm. long; *calyx-tube* deeply campanulate or subcylindric, 3.4-6 mm. long; *petals* purple or lilac-tinged, regularly or irregularly graduated, the keel-tip obtuse, acute, or triangular-acuminate; *pod* ascending or spreading, linear, linear-lanceolate, or -oblong in profile, straight or a little incurved, compressed-triquetrous, grooved dorsally, the valves papery; *dehiscence* apical, basal, and through the ventral suture, after falling; *ovules* 1-27.—Spp. 4, xerophytes of subtropical desert climate, southeastern Utah, Arizona (Grand Canyon southward) and southern New Mexico to Durango and Sinaloa.

ASTRAGALUS sect. LEPTOCARPI subsect. PRINGLEANI, subsect. nov., subsect. *Californici* proximi, vix nisi calycis tubo profundius campanulato et radice saepissime perenni vel bienni absimiles. A subsect. *Parvis* floribus majusculis, ab *Arizonicis* pube basifixis, a *Coahuilanicis* legumine max deciduo ulterius distant. Plantae in idoneis certe biennibus in asperis nonnumquam annuae evadunt.—Sp. typica: *A. Pringlei* Wats.

The *Pringlei* are distinguished from the subsections immediately following chiefly by their deeply campanulate calyx-tube and further from the *Parvi* by their longer flowers, from *Arizonici* by their basifixed vesture, and from *Coahuilani* by their deciduous pod. The nucleus of the subsection consists of *A. Pringlei* and *A. nothoxys*, a closely related pair of species which in the past has been rather widely separated taxonomically on account of the latter's ordinarily

acute or acuminate appendaged keel-tip, a feature once believed to indicate a close relationship with the annual *A. acutirostris*, but neither unique to the two of them nor even constantly present in one of them. Of the two species described in recent years *A. Bryantii* differs from the typical elements in its taller, erect habit of growth, and loose, ascending racemes of rather large flowers. The last in order, *A. Gentryi*, is apparently the least soundly perennial of the subsection, possibly as often as not monocarpic, but certainly sometimes at least biennial. It resembles some truly annual *Californici*, and its modified flower with exerted beaklike keel-tip is quite like that of *A. arizonicus*; it is a transitional species, serving to link the first four subsections of *Leptocarpus* into a unit. The *Pringleani* are not easily distinguished from subsect. *Californici*, considered collectively, although very little difficulty is anticipated in any particular case, their areas of dispersal being so largely different, and the distinction between a fleeting annual root and one early indurated and perennant being usually clear enough. However *A. (Californici) Emoryanus*, an annual with occasional biennial phases, is sympatric with at least three of the *Pringleani*. In order to forestall confusion it is mentioned in the following key.

Key to the Species of Subsect. *Pringleani*

1. Stems diffuse or prostrate, (0.2) 0.5–3 (4) dm. long; *banner* about 8–16 mm. long, but if over 12 mm. long the *racemes* less than 15-flowered; *keel* less than 10 mm. long; *pod* 0.7–2.2 cm. long; widespread (2)
2. Petals regularly graduated, the keel (either acute or obtuse at apex) shorter than the wings; Arizona and New Mexico to Durango and Nuevo León (3)
3. Ovary and pod strigulose; *calyx-tube* deeply campanulate, 3.6–5.7 mm. long; if the *racemes* only 2–12-flowered, and the *pod* not over 11 mm. long and not over 15-ovulate, then the flowers relatively long (the *banner* 12.5–16 mm. long); if the *banner* only 8.5–12 mm. long, then the *racemes* 6–20-flowered and the *pod* mostly 1.5–2.2 cm. long and 17–26-ovulate (4)
4. Leaves mostly 3–9 cm. long and peduncles mostly 4–14 cm. long; *racemes* (4) 6–20 (25)-flowered, the axis (1) 1.5–9 cm. long in fruit; *flowers* relatively small, the *banner* 8.5–12 mm., the *keel* 6.5–8.4 mm. long; *pod* relatively long, (1.3) 1.5–2.2 cm. long; *ovules* (17) 18–26; Arizona and New Mexico to n. Sonora and n. Chihuahua 312. *A. nothoxys*
4. Leaves mostly 1.5–4.5 cm. long and peduncles mostly 0.5–5.5 cm. long; *racemes* 3–12-flowered, the axis 0.5–4 cm. long in fruit; *flowers* slightly longer, the *banner* 12.5–16 mm., the *keel* 8.6–9.8 mm. long; *pod* shorter, 7–11 mm. long; *ovules* 11–15; Chihuahua and Durango. 313. *A. Pringlei*
3. Ovary and pod glabrous; *calyx-tube* shallowly campanulate, 2–3.5 mm. long; *racemes* 2–10-flowered; *banner* $\pm$ 7–11 mm. long; *pod* 0.8–2.2 cm. long, 8–16-ovulate; cf. *A. (subsect. Californici) Emoryanus*.
2. Petals irregularly graduated, the triangular-acute keel-tip surpassing the wings by 0.2–0.8 mm., the shallowly lobed wing-blades relatively short (4–5 mm. long) and broad; Sonora and Sinaloa, s.-ward from Rio Mayo, and extreme w. Chihuahua 315. *A. Gentryi*
1. Stems taller, erect or ascending (3) 3.5–8 dm. long; *racemes* loosely 12–22-flowered; *banner* (13) 14–19.6 mm. long, *keel* $\pm$ 11.5–15 mm. long; *pod* (1.5) 2–3 cm. long; canyons of the Colorado River, n.-w. Arizona and extreme s. Utah. 314. *A. Bryantii*

312. *ASTRAGALUS NOTHOXYS*

Slender, diffuse, perennial but sometimes flowering the first season and seldom long-enduring, strigulose nearly throughout with fine, straight, appressed or sub-appressed hairs up to 0.25–0.5 mm. long, the herbage cinereous or greenish-glaucous beneath the vestiture, the leaflets glabrous or nearly so and of a yellowish-green tint above; *stems* several or numerous from the root-crown or shortly forking caudex, decumbent or prostrate with ascending tips, (1.5) 2.5–30 (40) cm. long, commonly branched near the base and sometimes spurred at one or more nodes preceding the first peduncle, forming loosely woven mats; *stipules* submembranous or broadly membranous-margined, pallid or purplish, 2–5.5 mm. long, ovate-triangular or the upper ones lance-acuminate, about semiamplexicaul; *leaves* (2) 3–9 (11.5) cm. long, slender-petioled but the uppermost ones shortly so, with (7) 9–21 obovate, oblong-obovate, broadly oblanceolate, oval, or (especially in some lower leaves) oval-suborbicular, obtuse or emarginate, flat or loosely folded

leaflets 2–12 (15) mm. long; *peduncles* slender, incurved-ascending at anthesis, recumbent in fruit, (3) 4–14 (15) cm. long, surpassing the leaf; *racemes* loosely (4) 6–20 (25)-flowered, the flowers ascending or spreading in age, the axis somewhat elongating, (1) 1.5–9 cm. long in fruit; *bracts* membranous, often purplish, triangular-ovate or lanceolate, 0.8–3 (3.5) mm. long; *pedicels* ascending, straight or nearly so, at anthesis slender, (0.5) 1–1.8 mm., in fruit a trifle thickened, 1.1–3.2 mm. long; *bracteoles* 0 (rarely a minute scale); *calyx* 5–7 mm. long, strigulose with white or mixed white and black hairs, the somewhat oblique disc 0.6–1.2 mm. deep, the membranous, often purplish tube 3.6–4.9 mm. long, 2.1–2.7 (2.9) mm. in diameter, the lance-subulate teeth 1.4–2.7 mm. long, the whole becoming papery, ruptured, persistent; *petals* pink-purple (drying bluish), the banner- and wing-tips often whitish; *banner* recurved through $\pm 45^\circ$, ovate- or obovate-cuneate, notched or subentire, 8.5–12 mm. long, 5–7.6 mm. wide; *wings* nearly as long as (rarely a trifle longer than) the banner, 8.6–11 mm. long, the claws 3.3–4.8 mm., the gently incurved blades 5.7–7.6 mm. long, either linear-oblong to oblanceolate and obtuse or truncate, or obliquely semiobovate and emarginate or shallowly bidentate, 1.7–3.6 mm. wide just below the apex; *keel* 6.5–8.4 mm. long, the claws 3.3–4.4 mm., the half-obovate blades 3.3–5 mm. long, 1.2–2.3 mm. wide, abruptly incurved through $85\text{--}95^\circ$ and produced at apex into an erect or strongly porrect, narrowly triangular or subulate, acute, straight or slightly decurved beak 0.4–0.9 mm. long, the tip exceptionally unappendaged, bluntly deltoid; *anthers* (0.35) 0.5–0.65 (0.7) mm. long; *pod* ascending, sessile on the scarcely elevated receptacle, linear-lanceolate or linear in profile, slightly incurved, (1.3) 1.5–2.2 cm. long, 2.3–3.5 (4) mm. in diameter, rounded at base, contracted at apex into a very short, triangular, laterally compressed, cuspidate beak, otherwise compressed-triquetrous with acute ventral and obtuse lateral angles, the lateral faces flat or nearly so, the dorsal face narrowly sulcate, the green or purplish, thinly or quite densely strigulose valves becoming papery, stramineous or brownish, delicately cross-reticulate, inflexed as a complete or nearly complete septum 1–1.6 mm. wide; *ovules* (17) 18–26; *seeds* dark or chestnut-brown, sometimes purple-dotted, pitted or wrinkled but somewhat lustrous, 1.8–2.9 mm. long.—Collections: 60 (ii); representative: *Jones* 26,076, 26,083 (CAS, POM); *Eastwood* 8152, 16,972 (CAS); *A. & R. Nelson* 1443 (NY, SMU); *McVaugh* 8086 (SMU, TEX); *Ripley & Barneby* 11,199 (CAS, RSA); *Hartman* 622 (NY, US).

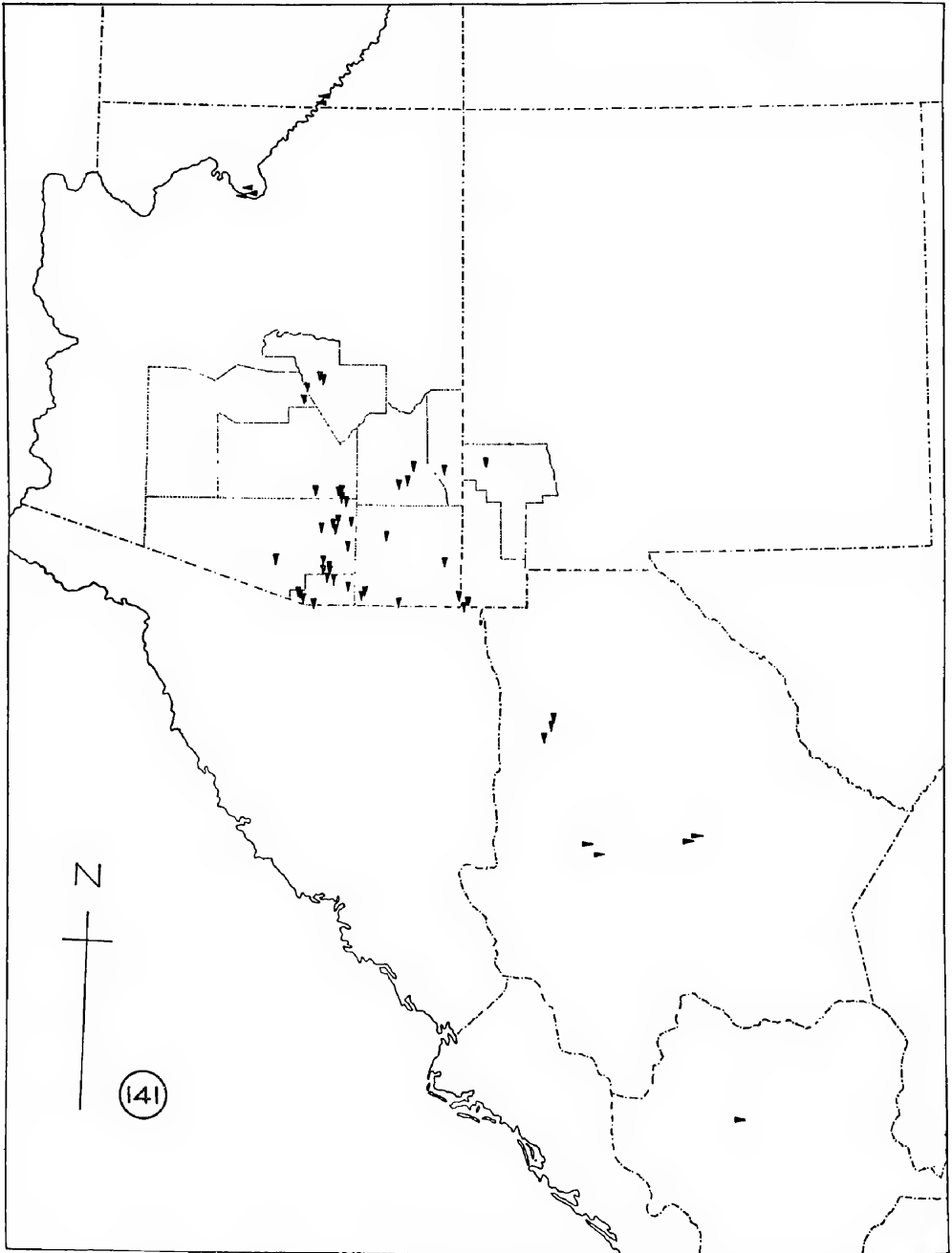
Open hillsides, valley floors, and sandy flats or stream beds, commonly among live oaks, about oak brush, or in juniper forest, sometimes in loose alluvium of washes or in disturbed soil along highways, without obvious rock preference, widespread, rather common and locally plentiful between 2700 and 6500 feet, (according to Kearney & Peebles as low as 1500 feet) over most of the upper Gila watershed in southeastern Arizona, southwestern New Mexico, northeastern Sonora, and south into the Mapimí drainage basin in northwestern Chihuahua.—Map No. 141.—(January) March to June, sometimes again after summer rains.

ASTRAGALUS NOTHOXYS (falsely acute, the keel-petals supposedly simulating *Oxytropis*) Gray in Proc. Amer. Acad. 6: 232. 1864.—“Arizona, formerly the northern part of the Mexican province of Sonora, Prof. Thurber. San Luis Mountain and Guadeloupe Canon, Capt. E. K. Smith, in herb Torr.”—Holotypus, collected by Thurber in 1851, NY! isotypus, GH (fragm.)! paratypi, GH (fragm.), NY!—*Tragacantha nothoxys* (Gray) O. Kze., Rev. Gen. 946. 1891. *Oxytropis nothoxys* (Gray) Jones in Proc. Calif. Acad. Sci. II, 5: 677. 1895. *Spiesia nothoxys* (Gray) Jones, l.c., nom. provis. *Aragallus nothoxys* (Gray) A. Hell., Cat. N. Amer. Pl. 4. 1898. *Hamosa nothoxys* (Gray) Rydb. in Bull. Torr. Club 54: 330. 1927.

Astragalus madrensis (of Sierra Madre Occidental) Jones, Rev. Astrag. 274, Pl. 69. 1923.—“Rather common in the Sierra Madres of Chihuahua Mexico, San Diego Cañon, Colonia

Juarez, and Sabinal, Jones."—Lectotypus, collected in San Diego Canyon, Sept. 16, 1903, *M. E. Jones*, POM (2 sheets)! paratypus (from Colonia Juarez, Sept. 11, 1903, *Jones*), POM! —*Hamosa madrensis* (*Jones*) Rydb. in *N. Amer. Fl.* 24: 426. 1929.

Hamosa Gooddingii (*Leslie Newton Goodding*, 1880—) Rydb. in *Bull. Torr. Club* 54: 20. 1927.—"Type collected on rocky slope in the Huachuca Mountains, Arizona, May, 1912, *L. N. Goodding* 1299..."—Holotypus, NY!—*Astragalus Gooddingii* (*Rydb.*) Tidest. in *Proc. Biol. Soc. Wash.* 48: 40. 1935 & op. cit. 50: 21. 1937.



Map No. 141. Arizona, New Mexico, Chihuahua, and parts of adjoining states. Range of  *A. nothoxys*; of  *A. Pringlei*; and of  *A. Bryantii*.

The beaked milk-vetch, *A. nothoxys*, might be taken as the prototype of its section, of which it has the characteristic narrowly oblong, linear, or linear-lanceolate, compressed-triangular, fully bilocular pod with a groove along the narrowest of the three faces opposed to the prominent but slender ventral suture. Among the perennial or potentially perennial species it may be recognized by its small leaflets of a pale subglaucescent green color, by the comparatively many, loosely racemose, pinkish-purple flowers, and by the ordinarily triangular-acuminate keel-tip. The latter varies from narrowly triangular and erect in a line with the outer curve of the keel-blade into a subulate-attenuate, outwardly arcuate (and thus porrect), cusplike appendage, and from nearly 1 mm. in length to a minute, rarely obsolete process. Whatever its shape, the cusp arises laterally, from the functional apex of the oblique petal, not terminally as in *Oxytropis*, with which *A. nothoxys* has been often but irrelevantly compared. In the type-collection of *Hamosa Gooddingii*, one plant, as described by Rydberg, has beakless keel-petals; another, mounted with it and otherwise indistinguishable, is normal *A. nothoxys*. The original description of *A. madrensis*, maintained by Rydberg as a species of *Hamosa* sect. *Tricarinatae*, is faulty in several respects, particularly in regard to the "reflexed" flowers and "deltoid and obtuse" keel-tip. The material from which the description was drawn consists of several plants collected in September; they are in a stage of renewed growth after autumnal rains, with tender new foliage starting from the middle and summit of indurated but formerly herbaceous stems, and thus they have a somewhat abnormal appearance. The best of these, from San Diego Canyon, has been chosen as lectotypus. It is the only one with flowers (about 2), which are clearly ascending from straight, erect pedicels, and the keel has the mucroniform appendage proper to *A. nothoxys*. The plants from Colonia Juarez should perhaps be considered cotypical, for they alone have good fruits, although these have already fallen and were probably picked off the ground, already dehiscent. The collection from Sabinal, although a mere fragment, is probably conspecific. Rydberg's description of the pod as "strongly reflexed" is impossible to reconcile with the stiffly erect fruiting pedicels of Jones's plant, and *Hamosa madrensis* seems to be a figment of the imagination. The Texan record of *A. madrensis* (Rydberg, l.c.) was based on a poor flowering specimen of *A. allochrous* collected near Fronteras by Bigelow (Mex. Bound. Surv. No. 261, NY).

In the live oak woodlands of southeastern Arizona *A. nothoxys* is locally abundant, especially on caliche soils. Like many plants injurious to man's interests, it flourishes in disturbed environments. On overgrazed and unwisely managed cattle ranges, it is often a serious pest, being one of the most greatly feared locoweeds of the region.

313. ASTRAGALUS PRINGLEI

Slender, prostrate or loosely matted, leafy and floriferous, perennial but sometimes flowering the first season, when mature with a woody taproot and shortly forking caudex, rather densely strigulose with straight, appressed or subappressed hairs up to 0.2–0.5 mm. long, the stems and herbage more or less cinereous, the leaflets bicolored, bluish-green and pubescent beneath, darker green and glabrous or medially glabrescent above; stems numerous, radiating, the principal ones (2) 4–15 (22) cm. long, freely branching at all the approximate lower nodes; stipules herbaceous, the lowest becoming papery in age, ovate, deltoid, or triangular, 1.5–3 mm. long, $\pm$ semiamplexicaul; leaves (1) 1.5–4.5 cm. long, with slender petioles and 7–15 oblanceolate or narrowly obovate-cuneate, retuse or truncate, sometimes obtuse, mostly involute or loosely folded, thick-textured leaflets 1.5–6 mm. long; peduncles slender, weakly ascending at anthesis, decumbent in fruit, 0.5–5.5 cm. long, those of the more vigorous stems surpassing, those of the branchlets shorter than the leaf; racemes loosely 3–12-flowered, the flowers ascending, the axis 0.5–4 cm. long in fruit; bracts ovate, 1–1.5 mm. long, at first herbaceous with membranous margins, becoming papery; pedicels slender, ascending, straight or flexuous, at anthesis 1.2–1.7 mm., in fruit 1.2–2.4 mm. long, naturally persistent after fall of the fruit but easily disjoining under pressure; bracteoles 0–2; calyx 5.8–8.5 mm. long, strigulose with white hairs, the turbinate disc 0.8–1.1 mm. deep, the membranous, deeply campanulate or cylindro-vase-shaped tube 4.3–5.7 mm. long, 2.4–2.9 mm. in diameter (the dorsal side straight or a little concave, the ventral side convex), the subulate teeth 1.5–2.8 mm. long, the whole becoming hyaline, a trifle distended but finally ruptured, marcescent; petals pale purple or whitish

tinged with lilac; *banner* gently recurved through $\pm 40^\circ$, 12.4–16 mm. long, the blade 3.4–4.3 mm. wide just above the cuneate claw and thence narrowly lance-oblong, shallowly emarginate at apex; *wings* 11.5–13.5 mm. long, the claws 4.7–5.6 mm., the linear-oblong or -oblanceolate, obtuse or erose-emarginate, straight or distally a little incurved blades 7.2–8.7 mm. long, 1.7–2.5 mm. wide; *keel* 8.6–9.8 mm. long, the claws 4.7–5.8 mm., the half-elliptic or obliquely triangular blades 4–4.6 mm. long, 2–2.3 mm. wide, incurved through about 85° to the obtuse, sharply triangular, or minutely cuspidate apex; *anthers* 0.55–0.75 mm. long; *pod* ascending (humistrate), sessile, oblong or lance-oblong in outline, straight or a trifle incurved, 7–11 mm. long, (2.1) 2.5–3.5 mm. in diameter, rounded at base, abruptly contracted distally into a very short, triangular-cuspidate beak, bluntly triquetrous, obtusely carinate by the rather thick but not prominent ventral suture, the lateral faces low-convex, the dorsal face deeply and openly sulcate, the thin, green or purple-tinged, finely strigulose valves becoming stramineous, delicately cross-reticulate, inflexed as a nearly or fully complete septum 0.5–0.7 mm. wide; *ovules* 11–15; *seeds* brown, purple-speckled, wrinkled and pitted but rather lustrous, 1.9–2.2 mm. long.—Collections: 5 (o); representative: *Palmer 18*, 89 (K, NY, US); *J. N. Rose 11,641* (US).

Dry sandy and gravelly plains, hillsides, and outwash fans, 4300–7400 feet, in mesquite-grassland or juniper-piñon forest, apparently uncommon, within and near the east foothills of the Sierra Madre, from westcentral Chihuahua south to westcentral Durango.—Map No. 141.—February to June.

ASTRAGALUS PRINGLEI (Cyrus Guernsey Pringle, 1838–1911, famed for the quantity and quality of his extensive plant collections from Mexico and s.-w. United States) Wats. in Proc. Amer. Acad. 21: 449. 1886.—“Plains near Chihuahua, Pringle, April, 1885 (no. 79).”—Holotypus, GH! isotypi, BM, G, K, NY, P (3 sheets), PH, US, WS!—*Hamosa Pringlei* (Wats.) Rydb. in Bull. Torr. Club 54: 336. 1927.

Astragalus Mexiae (Ynez Enriqueta Julietta Reygadas, née Mexia, 1870–1938, collected widely in Mexico, Alaska, S. America, etc.) Jones, Contrib. West. Bot. 18: 44. 1933.—“No. 2563, Mexia from the Rancho Colorado, Chihuahua, district of Guerrero, Mex., May 27 1929 2200 meters alt . . .”—Holotypus, POM! isotypi, CAS, G, MO, NY!

The Pringle milk-vetch is technically similar to *A. nothoxys*, differing from this close relative in its shorter leaves and peduncles, shorter racemes of fewer but larger flowers, and shorter, proportionately plumper pod. A modest, loosely matted plant, it is very free flowering and must be quite showy at full anthesis. The petals have been described as white (Rydb. 1929, p. 437); this is an error for there are traces of purple pigment in even the oldest specimens, and Mexia has them as “white tinged with lilac,” a phrase applicable also to the paler forms of *A. nothoxys*. The relationship of *A. Pringlei* to *A. nothoxys* was not appreciated by Rydb. who placed it in *Hamosa* sect. *Hartwegianae*, although he remarked (1927, p. 336) that it was habitually unlike the rest of that section. Jones (1923, p. 272, in cl. v) compared it with *A. parvus*, a much more delicately fashioned plant with tiny flowers. The identity of *A. Mexiae*, also compared by Jones with *A. parvus*, was first recognized by C. V. Morton (in Contrib. U. S. Nat. Herb. 29: 100. 1945).

314. ASTRAGALUS BRYANTII

Slender, rather tall, perennial, perhaps of short duration, with a taproot and incipient caudex, strigulose with appressed or subappressed hairs up to 0.5–0.9 mm. long, the stems and herbage green or cinereous, the leaflets $\pm$ bicolored, usually of a yellowish-green hue and glabrous above, darker green and thinly to densely pubescent beneath; *stems* several, erect or ascending, (3) 3.5–8 dm. long, simple or nearly so above the base, floriferous upward from near or above the middle; *stipules* 3–8 mm. long, the lowest early becoming papery and brownish, decurrent around half to the whole stem’s circumference but free, the median and upper ones herbaceous, thinly membranous-margined, with lance-, ovate-, or

deltoid-acuminate, mostly recurved or reflexed blades; *leaves* (4) 6–12 cm. long, petioled or the upper ones often subsessile, with (7) 11–21 ovate, obovate, suborbicular, or broadly elliptic, truncate-emarginate or shallowly retuse, flat leaflets (3) 5–15 mm. long; *peduncles* ascending, 4–8.5 (10) cm. long, shorter than the leaf; *racemes* loosely and openly 12–22-flowered, the flowers early spreading or a trifle declined, the axis early elongating, (4) 6–13 cm. long in fruit; *bracts* lanceolate-, ovate-, or linear-acuminate, membranous-margined, 2–3.5 mm. long; *pedicels* at anthesis ascending, 0.5–1.1 mm. long, in fruit ascending or a little arched outward, thickened, 1–3 mm. long, persistent; *bracteoles* 0–2, minute when present; *calyx* 7–9.3 mm. long, strigulose with black or mixed black and white hairs, the slightly oblique disc 1–1.5 mm. deep, the deeply campanulate or subcylindric tube 5.1–6.4 mm. long, 2.6–3.3 mm. in diameter, the slenderly subulate teeth (1.6) 1.9–3.4 mm. long, the whole becoming papery, ruptured, marcescent; *petals* purple, drying violet (sometimes pale), the wing-tips paler than the banner or white; *banner* recurved through $\pm 40\text{--}45^\circ$, rhombic-obovate or -oblanceolate, notched, (13) 14–19.5 mm. long, 7.4–10 mm. wide; *wings* (shorter or exceptionally a trifle longer than the banner) 12.6–16.5 mm. long, the claws 5.6–7 mm., the linear, linear-oblanceolate or -elliptic, obtuse, nearly straight blades 8.7–11 mm. long, 1.8–3 mm. wide; *keel* 11.6–15 mm. long, the claws 5.6–7.1 mm., the lunately half-obovate blades 6.6–8.5 mm. long, 2.6–3.9 mm. wide, incurved through $75\text{--}85^\circ$ to the broadly rounded apex; *anthers* 0.6–0.8 mm. long; *pod* horizontally spreading or widely ascending, sessile on the slightly elevated receptacle or incipient gynophore (up to 0.7 mm. long), linear or linear-lanceolate in profile, almost straight to gently incurved, (1.5) 2–2.7 (3) cm. long, (2.5) 3–5 mm. in diameter, broadly cuneate or rounded at base, abruptly acute or acuminate distally, compressed-triangular with nearly flat lateral faces and narrower, deeply grooved dorsal one, carinate ventrally by the suture, the lateral angles narrow but obtuse, the thin, green or often purple-speckled valves becoming papery, stramineous, delicately cross-reticulate, thinly strigulose to glabrous, inflexed as a complete septum 1.5–3.2 mm. long, the beak unilocular; *ovules* 22–27; *seeds* orange-brown, sparsely pitted, dull, 2–2.5 mm. long. Collections: 5 (o); representative: *Eastwood* 5991 (CAS, F, GH); *Xerpha* M. *Gaines* 828, 1005, 1009 (Ariz. State College Herb.)

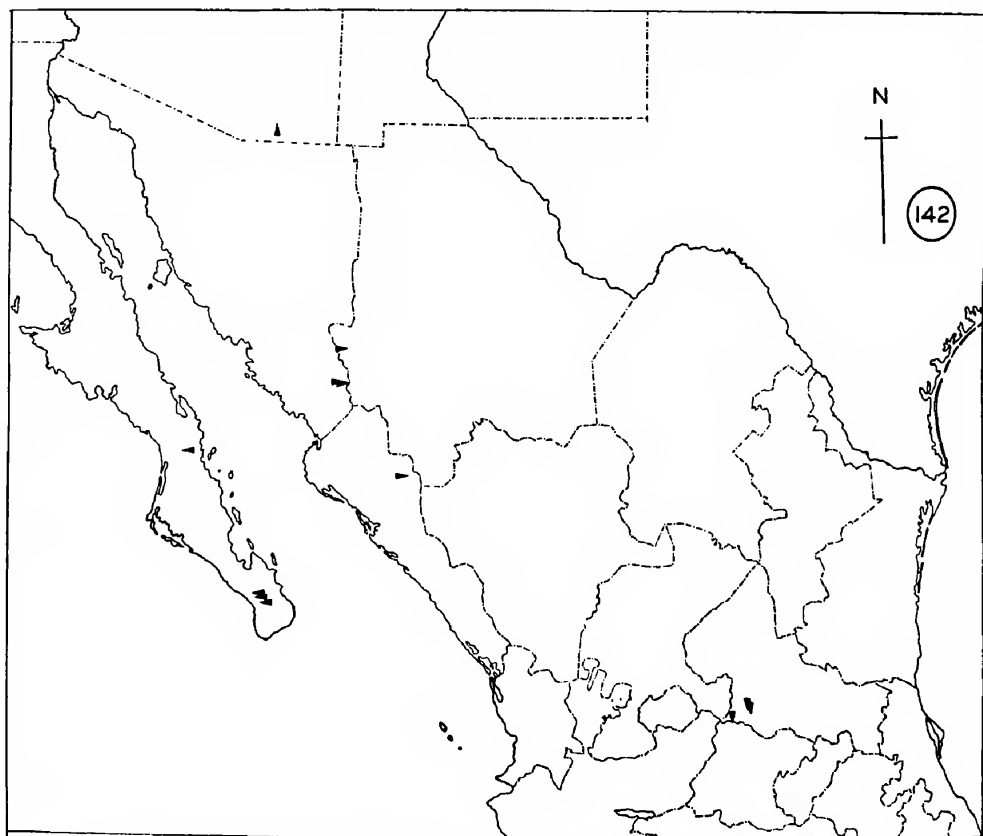
In sand, on talus, or on steep rock-strewn slopes, $\pm 2500\text{--}5000$ (perhaps 6000) feet, local, known only from the canyons of the Colorado River in southeastern Utah (Lost Eden Canyon and West Creek in Glen Canyon) and northern Arizona (Phantom Canyon and Clear and Hermit Creeks in Grand Canyon).—Map No. 141.—December to early June.

ASTRAGALUS BRYANTII (Harold Child Bryant, 1886—) Barneby in Proc. Calif. Acad. Sci. IV, 25: 156, Pl. 17, figs. 10–18. 1944.—“ARIZONA: at the head of Phantom Canyon in the Grand Canyon of the Colorado River, Coconino Co., 15 Dec. 1939. Collected by Dr. H. C. Bryant . . .”—Holotypus, CAS! isotypus, US!

The Bryant milk-vetch is the only large-flowered perennial member of its section known to occur in the canyons of the Colorado. It is likely to be confused there only with *A. lentiginosus* var. *palans*, the pod of which is terete or only a trifle compressed laterally, with convex rather than almost flat lateral faces, and a rounded or subdidymous rather than compressed-triangular section. The species is easily distinguished from the related but allopatric *A. nothoxys* by its taller, ascending or erect stems and much larger flowers, which resemble those of the Mexican *A. Pringlei* in length but are much more numerous and more loosely racemose. The pod of *A. Bryantii* varies a good deal in width and in outline from truly linear to lanceolate. It may be straight or nearly so, but is commonly incurved into a shallow crescent. The valves are ordinarily pubescent, at least thinly so; however, part of the type-collection has pods truly glabrous from the first.

315. *ASTRACALUS GENTRYI*

Slender, sparsely leafy, annual or biennial, perhaps sometimes shortly perennant, thinly strigulose with fine, straight, appressed and subappressed hairs up to 0.4–0.6 mm. long, the herbage green, the leaflets glabrous above; *stems* few, or in the second season several, from the crown of a subfiliform or at length woody but still slender taproot, prostrate and radiating, (0.25) 1–3 dm. long, simple, floriferous upward from near or well below the middle; *stipules* submembranous, triangular or lanceolate, 2–5 mm. long, about semiamplexicaul, glabrous or nearly so dorsally, the margins ciliate and often beset with a few minute processes; *leaves* (1.5) 2.5–8 cm. long, slenderly but the upper ones only shortly petioled, with (11) 13–17 ovate, oval, or broadly elliptic, truncate-emarginate, or obtuse and minutely apiculate, flat, thin-textured leaflets 2–10 mm. long; *peduncles* slender, straight and ascending or a little incurved, 4–10 cm. long; *racemes* shortly but loosely (3) 5–12-flowered, the flowers spreading or widely ascending, the axis somewhat elongating, 0.5–4.5 cm. long in fruit; *bracts* membranous, pallid or purplish, triangular or lanceolate, 1.1–2.4 mm. long; *pedicels* ascending or somewhat arched outward, at anthesis 0.5–1.4 mm., in fruit somewhat thickened, 1–2 mm. long; *bracteoles* 0; *calyx* 5–6.2 mm. long, thinly strigulose with mixed black and white or all white hairs, the oblique disc 0.5–1.1 mm. deep, the membranous, purplish, deeply campanulate or subcylindric tube 3.4–4.2 mm. long, 1.8–2.5 mm. in diameter, the subulate, subherbaceous teeth 1.4–2 mm. long, the whole becoming papery-membranous, ruptured, persistent; *petals* purple; *banner* recurved



Map No. 142. Northwestern Mexico and adjoining United States. Range of ▲ *A. hypoxylus*; of ◆ *A. parvus*; ♠ of *A. Gentryi*; and of ♣ *A. francisquitensis*.

through 45–60°, rhombic-obovate or obovate-spatulate, notched or subentire, 7.8–11.2 mm. long, 4.5–5.9 mm. wide; *wings* 6.8–8.8 mm. long, the claws 3.3–4.8 mm., the oblong-oblancoate or -obovate blades 4–4.7 mm. long, gently incurved distally and 1.5–2.2 mm. wide just below the shallowly and obtusely bidentate apex; *keel* (0.2–0.8 mm. longer than the wings) 7.2–9.3 mm. long, the claws 3.5–4.9 mm., the half-ovate-acuminate blades (3.7) 4–4.6 mm. long, 1.6–2.4 mm. wide, rather abruptly incurved through 70–90° into the narrowly triangular, acute, slightly porrect, beaklike apex; *anthers* 0.4–0.6 mm. long; *pod* ascending at a narrow angle, sessile on the slightly elevated receptacle, linear-lanceolate in profile, a trifle incurved, 1.1–1.5 cm. long, about 2.5 mm. in diameter, rounded at base, cuneately tapering distally into a short, triangular-acuminate or -cuspidate, laterally compressed unilocular beak, otherwise triquetrous, carinate ventrally by the suture, the lateral angles obtuse, the lateral faces flat or nearly so, the dorsal face narrowly sulcate, the thin, green, thinly and minutely strigulose valves becoming papery, stramineous, finely cross-reticulate, inflexed as a complete or nearly complete septum 0.8–1 mm. wide; *ovules* 13–16 (18); *seeds* dark brown, angled, smooth, scarcely lustrous, about 1.4 mm. long.—Collections: 6 (o); representative: *Gentry* 3648 (ARIZ, GH, K, MO), 7212 (NY), 8024 (ARIZ, DS); *Knobloch* 5009, 7048 (MSC).

Sandy stream beds and rocky canyon floors, 3500–6500 feet, in oak forest, west slope of the Sierra Madre Occidental in Sonora and Sinaloa, from the Rio Mayo south to the Sierra Surotato, and adjoining Chihuahua.—Map No. 142.—March to May.

ASTRAGALUS GENTRYI (Howard Scott Gentry, 1903–) Standl. in Field Mus. Bot. Ser. 22: 22. 1940.—“Mexico: San Bernardo, Rio Mayo, Sonora, . . . February, 1935, *Howard Scott Gentry* *xo* (type in Herb Field Mus.).”—Holotypus, not examined; isotypus (*Gentry* 1345), collected February 23, 1935, MICH!

The nearest affinity of the rather weedy, strongly characterized Gentry milk-vetch is not settled. It is perhaps misplaced in subsect. *Pringleani*, although its deeply campanulate calyx-tube is proper to the group. The individual flower most closely resembles that of *A. arizonicus* in the prominent keel with its narrowly triangular, porrect tip surpassing by a trifle the broad and short, notched blades of the wings; the habit of growth is also similar. However *A. arizonicus* differs greatly in appearance on account of the narrow, usually distant leaflets and the dense vesture of silvery dolabriform hairs. The life-span of the average plant of *A. Gentryi* is not known for certain. Gentry (Rio Mayo Pl. 145. 1942) describes the species as a winter-annual, and the majority of specimens I have examined are certainly flowering in the first year of growth. Others, however, have an indurated, even though always slender taproot which could hardly be expected of an obligate annual. The point requires observation in the field. Annual examples of *A. Gentryi* would naturally be sought among the *Californici*, and the species has been introduced into the key to that subsection. I can find there no closer ally than the Lower Californian *A. francisquitensis*, which differs greatly in fine detail of the flower.

A specimen of the Gentry milk-vetch (*Gentry* 3648, MO, cited by Gentry, Rio Mayo Pl. 145, as *A. Nuttallianus*) was annotated by me as an undescribed species before I had seen authentic material of *A. Gentryi*. The name proposed there was never published.

LXXIX (ii). Subsectio ARIZONICI

Perennials of rapid growth and short duration; *vesture* dolabriform; *leaflets* mostly 9–15; *flowers* about 10–30, ascending, rather small, the banner 9–12 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* purplish, somewhat irregularly graduated, the keel a trifle longer than the wings, its tip narrowly triangular, acute, porrect; *pod* erect or ascending, deciduous, linear-oblong in profile, straight or nearly so, obtusely triquetrous, the valves papery; *dehiscence* apical, tardily basal, and part way down through the ventral suture, after falling; *ovules* 14–22, usually 16–20.—Sp. 1, xerophyte, of the Gila River drainage, central and southern Arizona and northern Sonora.

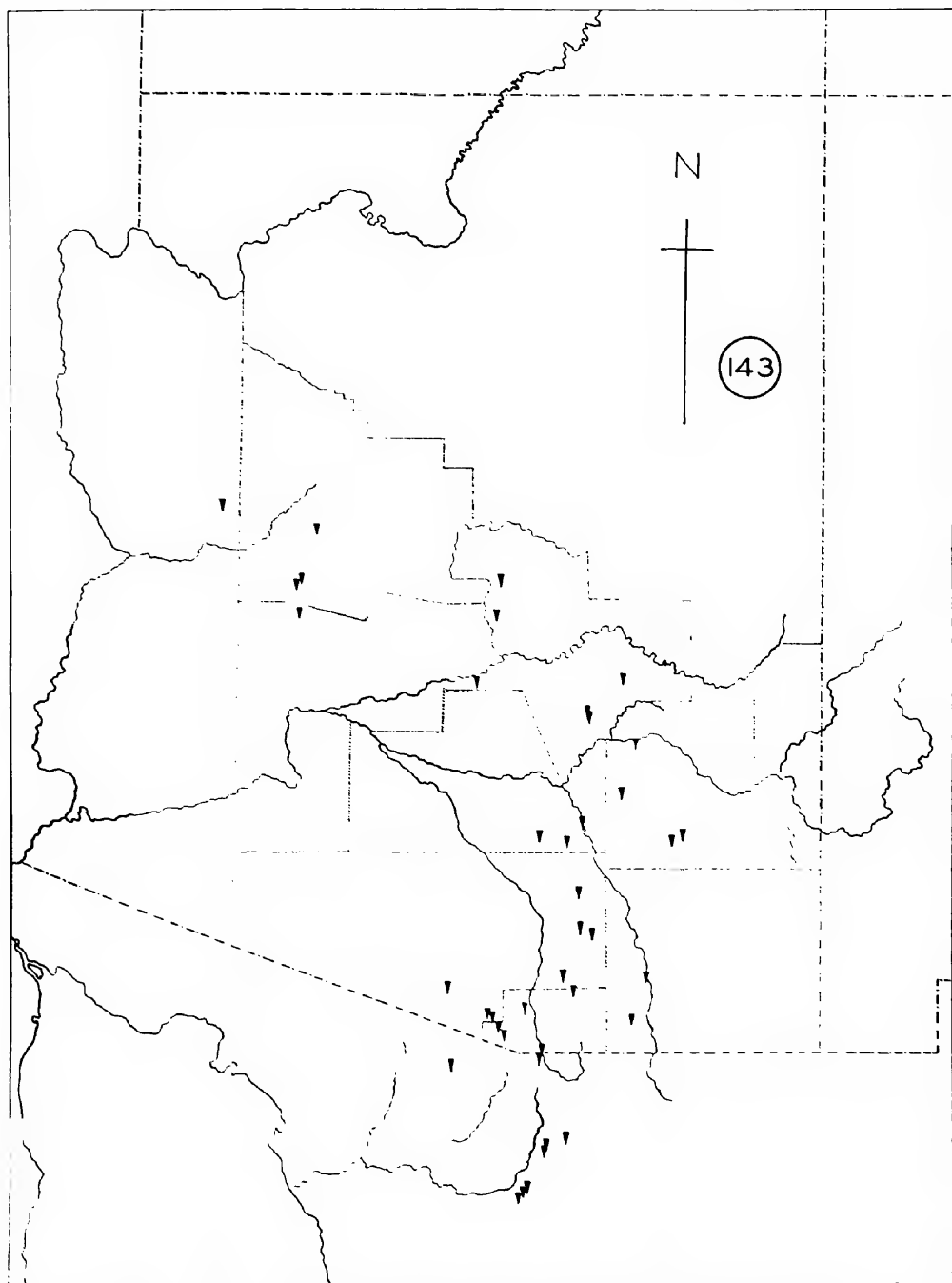
ASTRAGALUS sect. LEPTOCARPI subsect. ARIZONICI, subsect. nov., subsect. *Pringleanis* necnon *Californicis* proxime affines, ab ambabus pube dolabriformi, ad illis tubo calycino minus profunde campanulato, ab his radice perenni dispares. A sect. *Scaposis*, cum quibus a nonnullis associati, procul distant caulibus evolutis carinaque alis sublongiori acutiuscula porrecta.—Sp. unica: *A. arizonicus* Gray.

The single species for which a subsection is here proposed is evidently related in a general way to the *Pringleani*, *Parvi*, and *Californici*, from which it is distinguished by the dolabriform hair-attachment. In the form of the flower it agrees rather closely with *A. (Pringleani) Gentryi* of northwestern Mexico and with *A. (Tricarinati) bernardinus* of the Mohave Desert; it seems probable that the beaked keel has arisen independently from several lines of inheritance in sect. *Leptocarpi*, for these three species do not have much in common otherwise. Jones (1923, p. 254, in clave) associated *A. arizonicus* with *A. calycosus* (the typus of our sect. *Scaposis*) in a subsect. *Oxytropidoides* of sect. *Hamosi*, a group said to be "closely allied to *Oxytropis*," but demonstrably not so, and not, in my opinion, a natural group in *Astragalus*. Rydberg (1927, pp. 22, 23) considered it close to *A. coahuilae*, a species with basified pubescence, as in the subsections mentioned already, and a pod persistent until dehiscence.

316. ASTRAGALUS ARIZONICUS

Diffuse, usually slender, perennial but of short duration, sometimes flowering the first season, with a taproot and at length shortly forking caudex or knotty root-crown, strigulose throughout with filiform or largely flattened, straight, appressed (and sometimes a few narrowly ascending) hairs up to 0.4–0.8 (0.9) mm. long, the stems and herbage silvery-canescens or cinereous, rarely greenish-cinereous, the leaflets equally pubescent on both sides or more densely so above than beneath; *stems* several or numerous, decumbent or prostrate with ascending tips, (0.5) 1.5–4.5 (5) dm. long, simple, branched at base only, or spurred at most axils preceding the first peduncle, flexuous or zigzag distally, together forming loosely woven mats; *stipules* submembranous becoming papery and pallid, ovate- or deltoid-acuminate, or broadly triangular, about semiamplexicaul, pubescent dorsally; *leaves* 2–8 (10) cm. long, all petioled or the uppermost sometimes subsessile, with (5) 9–15 (17) linear, linear-oblong, -elliptic, narrowly lanceolate, or (when short) narrowly oval, obtuse, mucronulate, or acute, flat or folded leaflets (1.5) 3–17 (21) mm. long; *peduncles* erect or divaricate and incurved, (1.5) 2.5–10 (15) cm. long, the lower, more vigorous ones a little longer than the leaf, humistrate in fruit; *racemes* loosely or at first anthesis rather closely (7) 10–30-flowered, the flowers ascending, the axis elongating, (1.5) 2.5–10 cm. long in fruit; *bracts* membranous, ovate, triangular, or lanceolate, 0.8–2 (3) mm. long; *pedicels* ascending, usually at a narrow angle and straight or nearly so, at anthesis 0.5–1.6 (2) mm., in fruit 1–2.2 mm. long; *bracteoles* 0–2; *calyx* (4.5) 5–7 mm. long, strigulose with white or mixed white and black hairs, the symmetric disc 1–1.4 mm. deep, the campanulate tube 3.3–4.1 mm. long, 2.1–3.1 mm. in diameter, the broadly or slenderly subulate teeth (1.2) 1.4–3 mm. long, the whole becoming scarious, ruptured, marcescent; *petals* dull pink-purple, the banner with a pale, striate eye in the fold, the wing-tips paler or white, or all yellowish tinged with lurid lilac; *banner* recurved through about 50°, sometimes further in age, obovate-cuneate to suborbicular-flabellate, shallowly notched, (8.7) 9–12 mm. long, (6.1) 6.7–9.1 mm. wide; *wings* (6.8) 7.1–10 mm. long, the claws (2.4) 2.8–4 (4.3) mm., the narrowly oblong or oblong-oblancheolate, obtuse, nearly straight blades (4.7) 5–6.5 mm. long, 1.7–2.3 (2.5) mm. wide; *keel* (0.2–1 mm. longer than the wings, 0.3–2 (2.5) mm. shorter than the banner) 8.2–10.4 mm. long, the claws (2.6) 2.8–4 (4.4) mm., the lunately triangular blades (4.7) 5.2–6.5 mm. long, (1.9) 2.2–2.7 mm. wide, nearly erect in the lower half, thence abruptly incurved through 70–90° and produced into a narrowly triangular, porrect, acute or subacute, beaklike apex; *anthers* (0.4) 0.45–0.65 (0.7) mm. long; *pod* erect

or ascending, linear-oblong or linear in profile, straight or gently incurved, 1.5–3 cm. long, (2.2) 2.5–4 mm. in diameter, cuneate at base, contracted distally into a short, triangular-acuminate, stoutly cuspidate, laterally compressed, unilocular beak, otherwise obtusely triquetrous, bluntly carinate ventrally by the thick suture, the lateral angles rounded, the lateral faces more or less convex at maturity, the dorsal face flattened or very shallowly and openly sulcate (the dorsal suture slender



Map No. 143. Arizona and northern Sonora. Range of *A. arizonicus*.

but prominent externally), the thin, densely strigulose valves becoming papery, stramineous, finely elevate-reticulate, inflexed as a complete or nearly complete septum 1.4–3 mm. wide; *seeds* quadrate, brown or greenish-brown, commonly purple-dotted, pitted and wrinkled but somewhat shining, 1.8–2.6 (3) mm. long.—Collections: 43 (iii); representative: *Jones* (from Skull Valley) in 1903 (CAS, NY, POM, WS); *Eastwood* 17,021 (CAS, NY); *Barneby* 12,640, 12,645 (CAS, NY, RSA); *Eggleston* 19,898 (CAS, NY); *Keck* 3972 (DS, US); *Ferris* 8789 (DS, NY).

Open stony hillsides, alluvial fans, washes, and canyon beds, sometimes abundant on gravelly roadsides, in desert-grassland, thorn scrub, oak scrub, or juniper forest, 2800–4650 feet, on various soils but apparently most frequent and vigorous on calcareous formations, widespread and rather common in the foothills around and within the upper Gila River Basin, from the head of the Hassayampa to the Salt and San Pedro Rivers, westcentral to southeastern Arizona, and south to the head of the Magdalena River in northern Sonora.—Map No. 143.—March to June.

ASTRAGALUS ARIZONICUS (of Arizona) Gray in Proc. Amer. Acad. 7: 398. 1868 ("*Arizonicus*").—"Arizona, near Camp Grant, April, Dr. Edward Palmer."—Holotypus (*Palmer* 53), collected April 22, 1867, GH! isotypus, MO!—*Tragacantha arizonica* (Gray) O. Kze., Rev. Gen. 943. 1891. *Hamosa arizonica* (Gray) Rydb. in Bull. Torr. Club 54: 22. 1927.

The Arizona milk-vetch is the one species of its region in which an acutely triangular keel-tip is combined with a trigonous pod of narrow outline and a vesture of hairs attached laterally above the base; it is thus seldom misidentified. The herbage is thin and sparse, nearly always silvery-canescens, and the leaflets are commonly more densely hairy above than beneath. In the south half of its range it is sympatric and sometimes associated with *A. nothoxys*, a species technically similar but differing at first sight in its broader, bicolored leaflets, glabrous or nearly so above and only thinly strigulose beneath with basifixed hairs. The range of *A. arizonicus*, as known from reliably labeled specimens, is eminently a natural one. It has been reported from northern Arizona (Mohave and Coconino Counties) by Kearney (in Kearney & Peebles, 1951, p. 468), possibly by confusion with *A. Nuttallianus* var. *micranthiformis*, the common astragalus with "hamosoid" pod native to the south edge of the Colorado Basin. An old record (Hemsley, 1886, p. 28) from Coahuila was based on material of *A. coahuilae*, but Jones (1923, p. 257) still traced the Arizona milk-vetch south to "central Mexico," a doubtful statement. It is difficult to disprove even the most probably erroneous records, when the source-material was not identified in the first place and one has only negative evidence with which to confute them. Rydberg's range extension of *Hamosa arizonica* (1927, p. 22) into northwestern New Mexico is certainly wrong, being based on misidentified specimens of *A. albulus* (*Matthews* 12, from Fort Wingate, GH) and *A. proximus* (*C. F. Baker* 427, from Aztec, GH).

In the early spring months *A. arizonicus* makes an attractive picture, as it spreads its round mats of silvery foliage, decked with an outer ring of pink- or lavender-purple flowers, over the calcareous gravels between bushes of cat's-claw acacias, junipers, or sahuaros. Later in the season as the stems elongate and the fruits mature, the plants take on an untidy, withered look and are easily passed by unnoticed. The species was first discovered in flower in March, 1852, by C. C. Parry, then working for the Boundary Commission, at Tubac, Sonora, and at about the same time by Capt. E. K. Smith at Nogales. The specimens were noticed by Gray (1864, p. 234, No. 3) as representing an undescribed species which had been confused in the Botany of the Survey with *A. sonorae*. The fruiting typus was collected by Palmer almost immediately afterward.

LXXIX (iii). Subsectio MOHAVENSES

Winter-annual or perennial of short duration; *vesture* basifixed; *leaflets* 5–11; *racemes* loosely 3–16-flowered, the small flowers spreading or in age declined, the banner 7–12.5 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* pink-purple, little or irregularly graduated, the wings about equaling the keel or a little shorter than the subequal keel and banner, the keel-tip very obtuse; *pod* spreading or declined, readily deciduous, varying from plumply oblong and straight

to linear-oblong or -oblanceolate and lunately to hamately incurved, laterally or triquetrously compressed, subbilocular, the valves papery or leathery; *dehiscence* apical, after falling; *ovules* 8–30.—Spp. 2, xerophytes, of the Mohave Desert, southeastern California and southern Nevada.

ASTRAGALUS sect. LEPTOCARPI subsect. MOHAVENSES, subsect. nov., inter *Leptocarpos* ob foliola pauca (2–5-juga), pube albo-sericea et praesertim legumine patulo vel pendulo notabiles.—Sp. typica: *A. mohavensis* Wats.

The two species brought together in these pages to form subsect. *Mohavenses* have been widely separated in the classic texts on the genus. Rydberg (1927, p. 22; 1929, p. 425) placed *A. albens* next to *A. arizonicus*, believing them nearly related, but associated *A. mohavensis* with *A. Serenoi* in *Brachyphragma* sect. *Nuda*, an arrangement so unnatural as to imply a certain desperation in the search for its appropriate niche. Jones either did not know the true *A. albens* or was confused as to its identity, for the plant described under that name in his Revision is our *A. mohavensis* var. *hemigyrys*. This he placed in his sect. *Hamosi* (1923, p. 261) remote from the heterogeneous sect. *Lotiflori* (op. cit, p. 176) in which genuine *A. mohavensis* came to rest next to the Lower Californian monotype *A. circumdatus* (differing, inter alia, in connate stipules). While *A. albens* has been referred traditionally to some group equivalent to our *Leptocarpi*, the modified pod of genuine *A. mohavensis* has always presented difficulties in interpretation. Indeed if var. *hemigyrys* were lacking as a clue, the natural affinities of var. *mohavensis* would be almost indecipherable. Under *A. mohavensis* I have described in some detail the transitional stages leading from the "hamosoid" pod of *A. albens* into the straight, laterally compressed, bicarinate one of genuine var. *mohavensis*, which can be seen to be the outcome of a series of small evolutionary steps. The close relationship of the *Mohavenses* is best expressed, however, in the similarity of general appearance and ecology, and particularly in the modified flower which, because of the subequal length of the petals and the relative prominence of the broad keel, has a peculiar blunt or snub-nosed appearance in profile.

The affinities of subsect. *Mohavenses* within the framework of sect. *Leptocarpi* are not readily apparent. They might have been included in subsect. *Parvi*, except for the spreading or declined fruits combined with a characteristic flower, but I can find no really close resemblance outside their own small group, which is doubtless highly specialized.

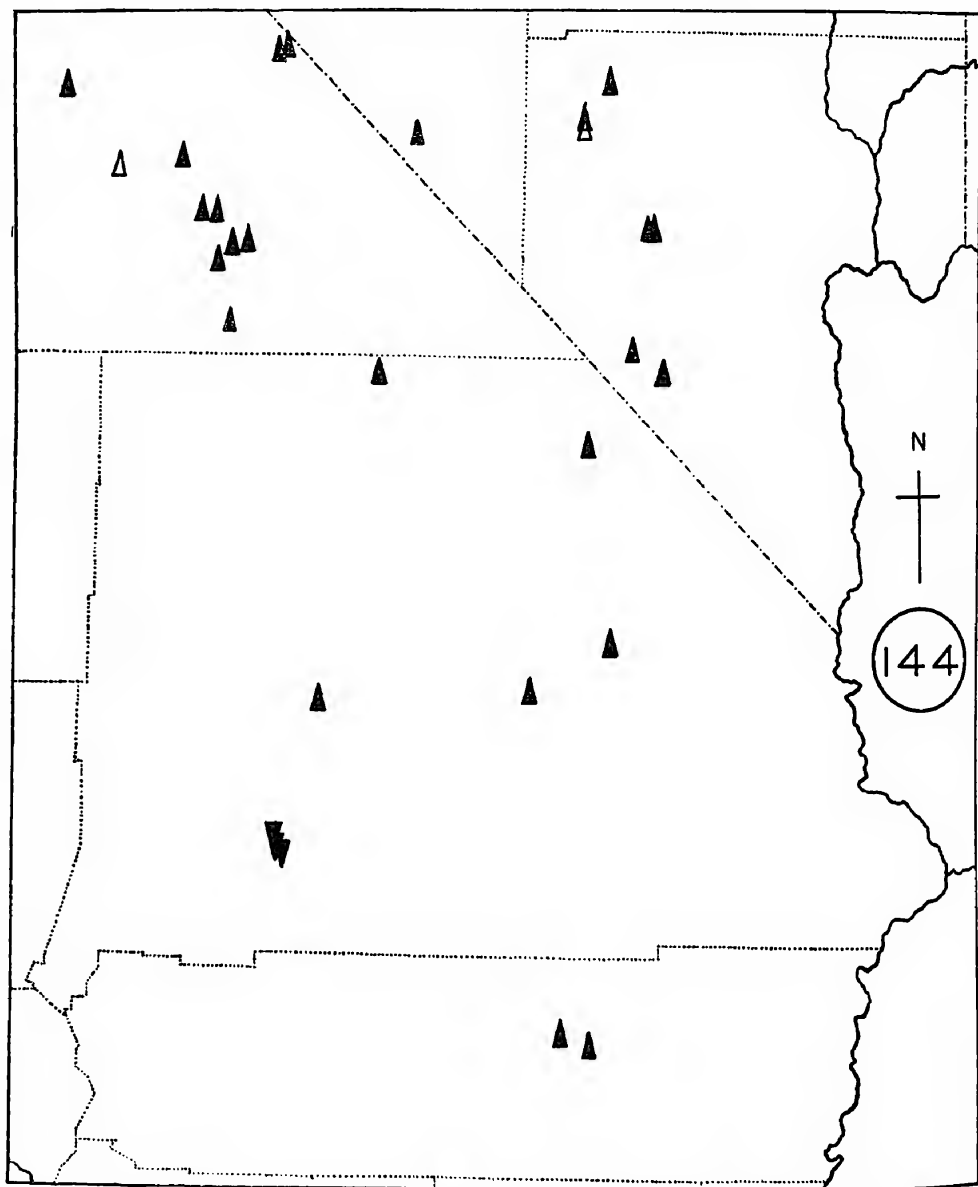
Key to the Species of Subsect. Mohavenses

1. Pod variable in size, compression, and curvature, (1.3) 1.5–3.2 cm. long, 3.5–8.5 mm. in diameter, the valves fleshy becoming stiffly papery or leathery; *ovules* 20–30; range of the subsection 318. *A. mohavensis*
1. Pod compressed-triquetrous, lunately incurved, 1.3–1.8 cm. long, 2.8–3.5 mm. in diameter, the valves thinly papery; *ovules* 8–11; local about e. end of San Bernardino Mountains 317. *A. albens*

317. ASTRAGALUS ALBENS

Delicate, diffuse, winter-annual or short-lived perennial, with a slender tap-root, densely strigulose nearly throughout with straight, flattened (and the shorter ones scalelike), truly appressed hairs up to 0.35–0.55 mm. long, the herbage silvery-canescens; *stems* several, prostrate or decumbent, radiating from the root-crown or (in older plants) from the divisions of a forking caudex, (2) 5–30 cm. long, branched or spurred at 1–several nodes preceding the first peduncle, floriferous upward from below the middle, zigzag distally, together forming loosely woven mats; *stipules* submembranous, greenish, less densely pubescent than the adjoining stem, deltoid or triangular, 1.8–3.5 mm. long, about semiamplexicaul; *leaves* (1) 1.5–4 (5.5) cm. long, all petioled, with (5) 7–9 obovate or oblong-oval and obtuse or emarginate, or some few rhombic-obovate and subacute, flat or loosely folded leaflets 2–11 mm. long; *peduncles* ascending at a wide angle, 1.5–4.5 (8) cm. long, either a little longer or shorter than the leaf; *racemes* loosely 5–14-flowered, the flowers widely spreading or in age declined, the axis 2.5–4.5 (8) cm. long in fruit; *bracts* membranous, ovate or lanceolate, 0.8–1.5 mm. long; *pedicels* at anthesis ascending and arched outward, 0.8–1.5 mm. long, in fruit either more

strongly arched, or abruptly divaricate, or sometimes contorted or geniculate at base, 1.4–2.5 mm. long; *bracteoles* 0; *calyx* 3.9–4.5 mm. long, densely strigulose with white and often a few black hairs, the subsymmetric disc 0.5–0.7 mm. deep, the campanulate, purple-tinged tube 2.2–2.7 mm. long, 1.6–1.9 mm. in diameter, the subulate teeth 1.4–2.3 mm. long, the whole becoming papery, persistent unruptured; *petals* pink-purple, drying violet or bluish, the banner with a pale, striate eye in the fold, irregularly graduated, the banner and keel of nearly equal length, the wings shorter than either; *banner* recurved through $\pm 40^\circ$, 7.3–9.5 mm. long, the shortly cuneate claw abruptly expanded into an ovate or subquadrately circular, shallowly emarginate blade 4.4–6.8 mm. wide; *wings* 6.2–7.5 mm. long,



Map No. 144. Parts of the Mohave and Colorado Deserts. Range of *A. mohavensis*: var. *mohavensis*; var. *hemigyris*; and of *A. albens*.

the claws 2.2–2.9 mm., the linear-oblongate or narrowly obovate, obtuse, nearly straight blades 4.8–5.7 mm. long, 1.2–2.4 mm. wide; *keel* 7–8.4 mm. long, the claws 2.6–3.4 mm., the obliquely triangular-obovate blades 4.9–5.7 mm. long, 2.7–3.3 mm. wide, abruptly incurved through about 90° to the broad, bluntly deltoid apex; *anthers* 0.35–0.55 mm. long; *pod* horizontal or commonly declined, sessile on a slender, glabrous gynophore 0.5–0.9 mm. long, narrowly lunate-oblongate in profile, incurved through about ¼–½ circle, 1.3–1.8 cm. long, acuminate tapering toward the base, 2.8–3.5 mm. wide just below the laterally compressed, triangular, cuspidate beak, otherwise compressed-triquetrous, with acute ventral and narrow but obtuse lateral angles, and broad, flat or slightly concave lateral and much narrower, sulcate dorsal faces, the thin, green or purplish-tinged, densely strigulose valves becoming papery, stramineous or brownish, inflexed below the beak as a nearly complete septum 1.3–2 mm. wide; *seeds* brown, smooth or nearly so, 1.8–2.6 mm. long.—Collections: 4 (ii); representative: *Jones* (from Cactus Flat) in 1926 (CAS, DS, NY, POM, US); *Barneby* 11,353 (CAS, NY, RSA).

Sandy or stony flats, rocky hillsides, canyon washes, and outwash fans, on granite or on mixed granitic and calcareous debris, very local but locally plentiful in years of sufficient rainfall, known only from Cushenbury Canyon in the north-east foothills of the San Bernardino Mountains, there extending from the desert edge (at about 4000 feet) near Box S Springs upward into the sagebrush zone on Cactus Flat (about 5800 feet).—Map No. 144.—Late March to May.

ASTRAGALUS ALBENS (turning white, of the silvery vesture) Greene in Bull. Calif. Acad. Sci. 1: 156. 1885—"Mohave Desert, May, 1882, S. B. & W. F. Parish, No. 1274."—Holotypus, CAS! isotypi, BM, GH, DS, ORE, POM, US, WS!—*Hamosa albens* (Greene) Rydb. in Bull. Torr. Club. 54: 22. 1927.

The Cushenbury milk-vetch, *A. albens*, is a plant of great delicacy. It might be visualized as a refined and diminished version of its common relative *A. mohavensis*, from which it is easily distinguished by its few-ovulate pod of more slender outline and papery texture. As does *A. mohavensis*, the plants flower precociously; and a good proportion of them are probably monocarpic, especially in years of low rainfall, after which the populations become decimated or even annihilated except for the dormant seeds. In the first spring after a drought of several seasons duration, whole colonies of young plants can be found in prolific flower and fruit, giving the impression of an obligately annual species, but this is certainly a misleading picture. The genuinely annual astragali with hamosoid pods native to the Mohave Desert differ from *A. albens* in their greenish foliage, or fewer flowers, or regularly graduated petals, or acute keel-tip, or in some combination of these characters.

Not at all rare in Cushenbury Canyon, where it is sometimes associated with another narrow endemic, *Erigeron Parishii* Gray, *A. albens* is one of the most narrowly localized species of its genus. The Mohave Desert is now so well explored botanically that we can hardly anticipate any substantial extension of its presently known range of about five miles in diameter. The report of *A. albens* from the Colorado Desert (Rydberg, 1927, l. c.) was based on a misidentified specimen of *A. lentiginosus* var. *borreganus*.

318. *ASTRAGALUS MOHAVENSIS*

Low, diffuse or loosely tufted, annual, winter-annual, or perennial of short duration, with a taproot, densely strigulose throughout with straight, appressed and narrowly ascending (rarely a few shorter, curly) hairs up to 0.45–0.8 mm. long, the stems and herbage silvery-white or rarely greenish-canescens; *stems* 1–several from the root-crown, decumbent and weakly ascending, mostly 0.5–3.5 dm., rarely 4–5 dm. long, or in some seedling but already fruiting plants as little as 1–2 cm. long, when vigorous then branched or spurred below the middle, flexuous distally; *stipules* membranous or thinly herbaceous, deltoid or lanceolate, 1–3.5 (5) mm. long, not more than semiamplexicaul; *leaves* 2–10 (12.5) cm. long, all petioled, with (3) 5–11 oval, rhombic-elliptic, obovate-cuneate, or suborbicular, obtuse or

(in some lower, rarely in some upper leaves) shallowly retuse, flat leaflets 3–18 mm. long; *peduncles* erect or divaricate and ascending, 1.5–7 (10) cm. long, often humistrate when weighed down by the fruits; *racemes* loosely 3–16-flowered, the flowers ascending at early anthesis, declined in age, the axis becoming 0.8–7 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–2.2 mm. long; *pedicels* at first slender, ascending, 0.6–1.2 mm. long, in fruit thickened, arched out- and downward, 1.5–3 mm. long; *bracteoles* commonly 2, minute, sometimes 0; *calyx* 4.4–7.2 mm. long, strigulose with white or mixed black and white hairs, the sub-symmetric disc 0.5–1.4 mm. deep, the campanulate tube 2.5–4.4 mm. long, 1.9–3.3 mm. in diameter, the subulate teeth 1.6–2.8 mm. long, the whole becoming papery, nearly always ruptured, marcescent; *petals* pale purple or pink-purple, the claws paler than the blades; *banner* gently recurved through about 45°, obovate-cuneate or broadly rhombic-oval, 7–12.5 mm. long, the midnerve sometimes running out as a minute tooth in the apical notch; *wings* 6.4–10 mm. long, the blades narrowly oblong or oblong-oblancheolate, truncate-erose or shallowly notched, straight or gently incurved distally; *keel* 0.4 mm. shorter to 0.7 mm. longer than the wings, the broadly half-obovate or obliquely and obtusely triangular blades abruptly incurved through 85–95° to the rounded apex; *anthers* 0.45–0.55 (0.6) mm. long; *pod* declined or pendulous, sessile on an obscure or subobsolete gynophore up to 0.8 mm. long, varying greatly in size and curvature from broadly and plumply oblong and straight to linear-oblong or -oblancheolate and crescentically or even hamately incurved, (1.3) 1.5–3.2 cm. long, 3.5–8.5 mm. in diameter, fleshy, solid, terete or nearly so when freshly formed, becoming (when straight) laterally or (when greatly incurved) triquetrously compressed in ripening, the thick, green, densely strigulose valves becoming stramineous or brownish, leathery or subligneous, prominently cross-reticulate and often wrinkled lengthwise, inflexed as a partial or nearly complete septum 1–2.5 mm. wide, the apex unilocular; *seeds* brown, nearly smooth or sparsely pitted, sublustrous, 2–3.5 mm. long.

The Mohave milk-vetch, a rather pretty desert species easily recognized by its few, densely silvery leaflets, and small, purple flowers giving rise to leathery or almost ligneous fruits, is of particular interest on account of the great variation in length, curvature, and compression of the ripe legume. The three types of variation are, however, causally related. Thus a short pod, or one unusually broad and therefore relatively short, is commonly straight or nearly so, and in ripening its lateral faces collapse inward, leaving the sutures equally prominent and equally convex. In a long and relatively narrow, or even a quite short, narrow pod a strong tendency toward inward curvature develops; and since the dorsal suture is no longer or scarcely longer than the ventral one, but is now obliged to describe the outer and therefore longer arc, it is drawn inward or depressed and produces a flattened or depressed dorsal face to the fruit. Even though almost terete in the fresh state, the incurved pod commonly becomes bluntly triquetrous in the course of ripening. Finally a narrow, strongly incurved or hooked pod is decidedly sulcate dorsally, even when first formed, and presents, when ripe, a decidedly obcordate section. There is evidence of transition from one extreme type of pod to the other, and *A. mohavensis* thus serves as a valuable example of the ease with which the *astragalus* pod may undergo apparently profound changes by simple means and independently of structural modification. The logic of a classification based solely on fruiting characters would have compelled Rydberg, had he known *A. hemigyris*, to refer it to *Hamosa* rather than to *Brachyphragma*, in which *A. mohavensis* had come uneasily to rest. Nevertheless I have no apology for treating them as varieties of a single species.

Key to the Varieties of *A. mohavensis*

1. Pod obliquely linear-oblancheolate, linear, or narrowly oblong in profile, lunately to strongly and hamately incurved, (1.3) 1.5–2.5 (3) cm. long, 3.5–5.5 (6.5) mm. in diameter, cuneate or attenuately tapering at base, abruptly contracted distally and cuspidate, when ripe becoming triquetrous or compressed-triquetrous, with acute ventral and rounded lateral angles, the lateral faces becoming concave toward the ventral suture, the dorsal face either as wide or narrower than the lateral ones, shallowly grooved, the cross-section obcordate; rare (Death Valley

- region and Charleston Mountains) 318a. var. *hemigyris*
1. Pod broadly and plumply oblong to oblong-ellipsoid, or widest above the middle and then clavately oblong in profile, straight or a trifle, rarely lunately incurved, 1.5–2.8 (3.2) cm. long, (5) 5.5–8.5 mm. in diameter, rounded or broadly cuneate at base, abruptly contracted and cuspidate at apex, becoming laterally compressed and (when straight) bicarinate by the prominent, cordlike sutures or (when incurved) obscurely compressed-triquetrous with dorsal suture then depressed but scarcely sulcate, the cross-section mostly rhombic-elliptic; widespread over the Mohave Desert in California and s. Nevada 318b. var. *mohavensis*

318a. ASTRAGALUS MOHAVENSIS var. HEMIGYRUS

Flowers slightly smaller than in var. *mohavensis*, the calyx 4–5.7 mm., its tube 2.5–3.2 mm. long, 1.7–2.4 mm. in diameter, the teeth 1.5–2.5 mm. long; banner 7–9 mm. long, 4.4–5.6 (6.2) mm. wide; wings 6.3–7.8 mm. long, the claws 2–2.9 mm., the blades 4.6–5.4 mm. long, 1.5–2.1 mm. wide; keel either slightly longer or shorter than the wings, the claws 2.4–3.3 mm., the blades 4–5.3 mm. long, 2.2–2.8 mm. wide; pod as described in the key; seeds 2–2.5 mm. long.—Collections: 6 (ii); representative: Jones (topotypus) in 1906 (DS); Clokey 7996 (NA, NY, WS); Clokey & Clokey 8593 (NA, NY, WS); Ripley & Barneby 3772 (CAS, GH, NY, RSA).

Rock ledges and arid gravelly hillsides in the *Larrea* belt, on limestone, 4100–5200 feet, rare and local, known only from near Indian Springs in the east foothills of the Charleston Mountains, Clark County, Nevada, and from Darwin Mesa, Inyo County, California.—Map No. 144.—April to June.

ASTRAGALUS MOHAVENSIS var. HEMIGYRUS (Clokey) Barneby in *El Aliso* 2: 207. 1950, based on *A. hemigyris* (half-coiled, of the hooked pod) Clokey in *Madroño* 6: 220, Pl. 27, figs. p–z. 1942.—“... south of Indian Springs ... April 18, 1939, Clokey 8409 (type).”—Holotypus, collected by C. B. & I. W. Clokey, UC (Herb. Clokey.)! isotypi, K, MINN, NA, OB, PH, RM, SMU, TEX, UC, US, WIS, WS!

The var. *hemigyris* is listed first in order because the trigonously compressed fruit is less highly modified than that of var. *mohavensis*, even though the rarity of the form and what is known of its dispersal suggest to the contrary a recent origin through mutation back to a more primitive type. The two known populations are in close agreement in every characteristic up to and including the flower, but differ somewhat in the form of the fruit. In the type-locality the pod is strongly and evenly incurved, or sometimes more abruptly hooked, the body describing at least half a circle; it is gradually attenuate at base, and the dorsal sulcus is closed or nearly so. In the plants from Darwin Mesa the pod is only crescentically incurved, cuneate at base, and more shallowly and openly sulcate. This variation is no greater, however, than that described below for var. *mohavensis*, and it seems logical to associate under the present name the two populations which have in common small flowers and dorsally grooved fruits. The two known stations lie within or at the edge of the established range of var. *mohavensis* and about one hundred miles apart. It is conceivable that they represent independent but nearly parallel modifications arising from the more widely dispersed Mohave milk-vetch. The pod on the plants from Darwin Mesa is not greatly different from the narrowest examples furnished by var. *mohavensis*, where the dorsal suture, normally prominent and keel-like at maturity, becomes perceptibly depressed. It is possible and even probable that further collecting in southern Nevada will show var. *hemigyris* to be commoner than is known today.

The var. *hemigyris* was first collected at the type-locality by Marcus Jones in 1906, but was mistaken by him for the related *A. albens*. The description of the latter in Jones's Revision (1923, p. 261) applies chiefly, that of the pod entirely, to var. *hemigyris*, although the fruit illustrated on Plate 66 is that of var. *albans*.

318b. ASTRAGALUS MOHAVENSIS var. MOHAVENSIS

Calyx 4.9–7.2 mm. long, the tube 2.7–4.4 mm. long, 2.3–3.3 mm. in diameter, the teeth 1.8–2.8 mm. long; banner (8.8) 9–12.5 mm. long, 5.5–8 mm. wide; wings 7.8–10 mm. long, the claws 2.4–4.5 mm., the blades 5.4–6.5 mm. long, 2.1–2.6 mm. wide; keel (0.1 mm. longer to 0.4 mm. shorter than the wings) 7.5–9.6 mm. long, the claws 2.9–4.7 mm., the blades 4.9–5.8 mm. long, 2.6–3.4

mm. wide; *pod* as described in the key; *seeds* 2.6–3.5 mm. long.—Collections: 24 (iv); representative: *Ferris* 7938 (CAS, NY, OB, WS); *Munz* 16,435 (CAS, POM); *Coville & Funston* 501 (NY); *Clokey* 7991 (NA, NY); *Peebles & Loomis* 165 (NY); *Ripley & Barneby* 2921, 3323 (RSA).

Dry rocky slopes and flats in the foothills of desert mountains, along boulder-strewn washes, and on rock ledges of canyon walls, mostly 2500–7500 feet, descending in Death Valley to 1200 feet, most common in the *Larrea* belt but ascending into the piñon-juniper forest, apparently more abundant on limestone but not exclusively calciphile, well distributed and locally plentiful in the northern Mohave Desert, from the Death Valley region in Inyo County, California, east to the Pintwater and Charleston Mountains in Clark County, Nevada, south, becoming rarer, to the north edge of the Colorado Desert in the Eagle Mountains and Pinto Basin, interior Riverside County, California.—Map No. 144.—April to June.

ASTRAGALUS MOHAVENSIS (of Mohave River) Wats. in Proc. Amer. Acad. 20: 361. 1885 ("Mohavensis").—"In a cañon south of Newberry Spring in the Mohave Valley, in large depressed masses, by Mr. and Mrs. J. G. Lemmon, May, 1884."—Holotypus (*Lemmon* 3117, dated "April, 1884"), GH! isotypi, K, P!—*Brachyphragma mohavense* (Wats.) Rydb. in N. Amer. Fl. 24: 400. 1929.

The Mohave milk-vetch is well adapted to life under desert conditions, for although potentially perennial the plants are of rapid growth, in dry seasons flowering and beginning to fruit as month-old seedlings an inch or two in height, thereby ensuring the future of their sort. With ample moisture at the appropriate moments, the plants become much larger, but only rarely form the large masses described by Lemmon. Erect when young or short, the stems early become diffuse; when anchored in rock fissures, they hang down to form a silvery curtain of foliage against the canyon wall. The species may be recognized among other annual and short-lived milk-vetches of the Mohave by its few, broad, canescent leaflets, and by the plumply oblong-ellipsoid or sausage-shaped pod of solid, at first succulent, translucently green and lustrous aspect, which eventually shrinks into a hard, wrinkled, straw-colored shell girdled by the salient sutures. Because of the weight of water within the juicy mesocarp, the young pods are usually humistrate, or hang vertically from pendulous racemes and become technically erect in relation to the raceme-axis. Moreover their lack of angles permit them to roll or fall at random attitudes when laid into the press, and the naturally pendulous orientation is therefore often disguised in herbarium specimens. Variations in form and curvature of the pod, which is most often subsymmetrically oblong, is described in the varietal key. The flowers, though small, are of a lively pink-purple enhanced by a striate eye in the banner and, as seen in profile, have a characteristic blunt-ended look, due to the prominent keel which about equals the wings and is scarcely shorter than the banner.

LXXIX (iv). Subsectio PARVI

Perennial (sometimes flowering the first season); *vesture* basifixed; *leaflets* 11–19; *racemes* shortly 5–17-flowered, the small flowers spreading-ascending at full anthesis, the banner $\pm$ 7.5–9 mm. long; *pedicels* persistent or tardily deciduous under pressure; *petals* purple or lilac, the very obtuse keel shortest, the wings sometimes equaling the banner; *pod* ascending, readily deciduous, linear-oblong in profile, little or not incurved, bluntly triquetrous, bilocular, the valves papery; *dehiscence* probably both apical and basal; *ovules* 6–26.—Spp. 2, xerophytes, one of extreme southern Arizona, one of San Luis Potosí.

ASTRAGALUS sect. *LEPTOCARPI* subsect. *PARVI*, subsect. nov., subsect. *Pringleanis* ut supra descriptis proximi, praesertim floribus parvulis tuboque calycino breviter campanulato absimiles.—Sp. typica: *A. parvus* Hemsl.

The two members of subsect. *Parvi* were referred by Jones to his sect. *Micranthi*, and by Rydberg (1929, p. 436) to *Hamosa* sect. *Hartwegianae*. They differ collectively from *A. Hartwegi* and its near kindred by their short racemes of ascending flowers and in consequence have very nearly the facies of *A. Pringlei* and *A. nothoxys* of subsect. *Pringleani*, from which they have been separated, perhaps too artificially, by a shallowly bell-shaped calyx-tube and shorter flower. Both species are rare and poorly known.

Key to the Species of Subsect. Parvi

1. Leaflets narrowly oblong-ob lanceolate to linear-elliptic; *pod* (8) 9–19 mm. long; *ovules* 12–26; San Luis Potosí 319. *A. parvus*
 1. Leaflets obovate; *pod* 7–9 mm. long; *ovules* 6; s.-e. Arizona 320. *A. hypoxylus*

319. ASTRAGALUS PARVUS

Low, slender, loosely tufted, with a taproot and superficial root-crown or shortly forking caudex, strigulose nearly throughout with appressed hairs up to 0.25–0.5 mm. long, the herbage greenish or subcinereous, the leaflets glabrous above; *stems* diffuse and ascending, 3–20 cm. long, sparingly branched or spurred near the base, floriferous from near or well below the middle; *stipules* 1.5–4.5 mm. long, the lowest ones small, ovate-deltoid, early becoming papery and brownish, the upper ones broadly or narrowly lanceolate, herbaceous, mostly erect; *leaves* (1.5) 2–9 cm. long, slender-petioled, with (7) 9–17 (19) narrowly oblong-obovate to oblanceolate or linear-elliptic, obtuse to deeply emarginate, flat or loosely folded leaflets (1.5) 3–10 mm. long; *peduncles* slender, (2) 3–7 cm. long, reclinate in fruit; *racemes* shortly but loosely (3) 5–12-flowered, the flowers spreading-ascending at anthesis, the axis little elongating, 4–16 (24) mm. long in fruit; *bracts* submembranous, ovate-subulate to linear-lanceolate, 1–2 mm. long; *pedicels* very slender, at anthesis 0.4–0.7 mm., in fruit little thickened, 1–1.8 mm. long, persistent (or perhaps very tardily disjointing); *bracteoles* 0; *calyx* 4–5.1 mm. long, white-strigulose, the subsymmetric disc 0.6–0.8 mm. deep, the rather narrowly campanulate or turbinate-campanulate, pinkish tube 2.3–3.1 mm. long, 1.3–2.1 mm. in diameter, the subulate teeth 1.4–2 mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* pale purple; *banner* recurved through $\pm 40^\circ$, rhombic-ob lanceolate or obovate-cuneate, notched, 7.5–9 mm. long, 3.5–5.8 mm. wide; *wings* almost as long or a trifle longer, the claws 2.8–3.1 mm., the narrowly oblong or linear-ob lanceolate, obtuse or obliquely truncate-emarginate blades 4.8–6.5 mm. long, 1.3–2 mm. wide, both gently incurved but the left one sometimes further than the right; *keel* 5.4–6.2 mm. long, the claws 2.8–3.1 mm., the half-obovate blades 2.7–3.3 mm. long 1.4–2 mm. wide, incurved through $95\text{--}100^\circ$ to the rounded apex; *anthers* 0.3–0.5 mm. long; *pod* ascending, sessile on an obscure, incipient gynophore, linear-oblong in profile, straight or slightly incurved, (8) 9–19 mm. long, (2) 2.5–3.7 mm. in diameter, obtuse at base, contracted distally into a short, compressed-triangular, cuspidate beak, otherwise bluntly triquetrous, with rounded lateral and bluntly keeled ventral angles, the lateral faces at first plane becoming convexly distended in age, the dorsal face openly and shallowly sulcate, the thin, green or purplish, sparsely strigulose valves becoming papery, stramineous, inflexed as a partial or complete septum (0.3) 0.6–1.3 mm. wide; *dehiscence* apparently both apical and basal after falling; *seeds* (little known) brown, wrinkled and pitted, sublustrous, 1.6–2.3 mm. long;—Collections: 3 (o); representative: Gómez 276 (NY).

Arid grasslands, ± 7000 feet, known only from southwestern San Luis Potosí (near San Luis; Villa de Arriaga).—Map No. 142.—May–June, sometimes again in fall.

ASTRAGALUS PARVUS (small) Hemsl., Biol. Centr.-Amer., Bot. 1: 226. 1880.—“North Mexico, region of San Luis Potosi, 6000 to 8000 feet (Pary & Palmer 174) . . .”—Holotypus, K! isotypi, BM, GH, K, MO, NY, P, US!—*Tragacantha parva* (Hemsl.) O. Kze., Rev. Gen. 947. 1891. *Hamosa parva* (Hemsl.) Rydb. in Bull. Torr. Club 54: 335. 1927.

Astragalus Schaffneri (J. G. [Wilhelm] Schaffner, —1882) Jones, Rev. Astrag. 276, Pl. 69, 70. 1923.—“No. 815 Schaffner from San Luis Potosi Mexico.”—Holotypus (No. 611/815, collected in 1879), US! isotypi, GH (in part, mixed with *A. esperanzae*), BM, CAS, K, NY, P!

The central and northern states of Mexico are rich in small-flowered astragali with three-sided linear pods; comparatively few of them, however, are likely to be confused with *A. parvus*. Either their flowers or fruits, and commonly both, are early deflexed, or at least some stipules low on the main stems are united into a sheath. All the Mexican species with ascending hamosoid pod and free stipules are members of the present sect. *Leptocarpi*, the majority being obligate annuals, whereas *A. parvus*, at least when mature, has a decidedly woody root and indurated caudex; the other perennial *Leptocarpi* have much larger flowers. In the arid hill-country west of San Luis the Schaffner milk-vetch, *A. parvus*, is sympatric with the singular *A. diphacus* which it resembles closely in flower-size and habit of growth. The latter is quickly recognized, however, as soon as its didymously swollen fruits begin to form.

The type-collection of *A. Schaffneri* was distributed partly as *Schaffner 611* and partly as *Schaffner 815*; some labels bear both numbers, and it is clear that all form part of a single gathering. Watson (in Proc. Amer. Acad. 17: 343. 1882) identified the isotypus at GH as a luxuriant form of *A. parvus*, but it may be more correct to envisage the holotypus of *A. parvus* as somewhat depauperate and Schaffner's material as normally developed under favorable conditions of soil and rainfall. Jones distinguished *A. Schaffneri* from *A. parvus* by a broader pod, but I must agree with Rydberg that the slight difference in this respect is to be interpreted as an individual variation, such as occurs in the vast majority of astragali.

320. ASTRAGALUS HYPOXYLUS

Low, perennial, with basally indurated stems, strigulose with subappressed hairs up to 0.2 mm. long, the herbage cinereous, the leaflets bicolored, gray beneath, yellowish-green and glabrous above, white-ciliate; *stems* of the season very short, up to 4 cm. long, simple above the immediate base, decumbent; *stipules* deltoid, rather firmly herbaceous becoming papery and brownish, 1–1.5 mm. long, thinly strigulose dorsally; *leaves* 1.5–4 cm. long, with slender petioles and 11–13 obovate, obtuse, flat or loosely folded leaflets 2–4.5 mm. long; *peduncles* slender, 5–7 cm. long, greatly surpassing the leaves, prostrate and radiating in fruit; *racemes* densely and shortly 8–18-flowered, the flowers and fruits both ascending, the axis little or not elongating, 1–2.5 cm. long in fruit; *bracts* lanceolate or triangular-subulate, 1.3–2.5 mm. long; *pedicels* ascending, in fruit straight, thickened, persistent, $\pm$ 1.5 mm. long; *bracteoles* 0; *calyx* $\pm$ 6 mm. long, strigulose-villosulous with white hairs, the disc scarcely oblique, the campanulate tube 3.2 mm. long, 2 mm. in diameter, the lance-subulate teeth $\pm$ 2.8 mm. long, the whole becoming membranous, ruptured, persistent; *petals* purplish (or at least lilac-tinged); *banner* recurved through 45° (?), 7.5–8 mm. long; *wings* a little shorter, the claws nearly 3 mm. long, the blades lanceolate, little incurved; *keel* 5.8–6.2 mm. long, the claws $\pm$ 3.1 mm., the half-obovate blades 2.9–3.2 mm. long, 1.8 mm. wide, abruptly incurved through 95° to the bluntly deltoid apex; *pod* ascending, sessile on and deciduous from the convex receptacle, narrowly lanceolate in profile, 7–9 mm. long, 2–2.5 mm. in diameter, very slightly incurved, obtuse at base, contracted at apex into a short, glabrescent cusp, triquetrously compressed, with rounded lateral angles, carinate ventrally by the suture, deeply sulcate dorsally, the green, loosely strigulose valves becoming stiffly papery, stramineous, obscurely reticulate, inflexed as a complete septum $\pm$ 1 mm. wide; *ovules* 6 (possibly more?); *dehiscence* and *seeds* not seen.—Collections: 1 (the typus).

Habitat not recorded, known only from the type-locality, "near Fort Huachuca," in southwestern Cochise County, Arizona; to be sought in the mountains about the head of the San Pedro and Santa Cruz Rivers in southeastern Arizona and adjoining Sonora.—Map No. 142.—June and July, probably flowering in early spring.

ASTRAGALUS HYPOXYLUS (woody below) Wats. in Proc. Amer. Acad. 18: 192. 1883.—"Collected at Maloney's Ranch, in the Huachuca Mountains, Southern Arizona, by J. G. Lemmon, in July, 1882."—Holotypus (*Lemmon 2656*), GH! isotypus, UC!—*Hamosa hypoxyla* (Wats.) Rydb. in Bull. Torr. Club 54: 336. 1927.

The type-specimen of the Huachuca milk-vetch, *A. hypoxylus*, which has no root and only faded and mostly broken flowers, is hardly sufficient for analysis; nevertheless it demonstrates what seems to be a very distinct species. The epithet *hypoxylus* refers to the ligneous lower stem which is, perhaps, not altogether typical and not part of a true caudex as the term is used in these pages; it suggests rather the growth of early spring which has become hardened and has given rise to short, new herbaceous shoots under the stimulus of early summer rains. The typus of Jones's *A. madrensis* shows that a similar condition may occur late in the year in *A. nothoxys*. Around Fort Huachuca *A. nothoxys* is locally abundant and must be sympatric with *A. hypoxylus*, if the locality data are correct. The two species are similar in many technical features, including the form of the fruit, and in superficial matters of pubescence and of coloring of the flowers and leaves. Differential points to be looked for in *A. hypoxylus* are the crowded racemes elevated on very slender peduncles well beyond the foliage and the much shorter, few-ovulate pod. Further the calyx of *A. hypoxylus* is more deeply cleft so that the teeth are longer in proportion to the more shallowly campanulate tube; and the keel-tip lacks the terminal cusp which is nearly always characteristic of *A. nothoxys*.

A collection from Puebla (*Purpus* 2477) referred to *A. hypoxylus* by Jones (1923, p. 278) was identified by the same author (op. cit., p. 275) as *A. luisanus*. Like the holotypus of *A. luisanus* it belongs to *A. hypoleucus* Schau.

LXXIX (v). Subsectio TRICARINATI

Perennials; *vesture* basifixed; *leaflets* 11–27; *flowers* loosely racemose (about 7–25), spreading-ascending, of small or medium size, the banner about 7–15.5 mm. long; *pedicels* persistent; *calyx-tube* campanulate; *petals* slightly graduated or of subequal length, ochroleucous or purplish, the keel-tip bluntly deltoid or sharply triangular; *pod* erect or ascending at a narrow angle, sessile on and deciduous from a stout gynophore 0.7–2.5 mm. long, the body (mostly 2–4 cm. long) narrowly oblanceolate in profile, straight or a little incurved, triquetrous with 3 subequally broad faces (the dorsal one at first a little depressed becoming nearly plane in age), fully bilocular, the valves papery, glabrous; *dehiscence* apical and basal, after falling; *ovules* 19–28.—Spp. 2, xerophytes of the southern and eastern Mohave and northern Colorado Deserts, southeastern California.

ASTRAGALUS sect. LEPTOCARPI subsect. TRICARINATI, stat. nov., based on *Hamosa* sect. *Tricarinatae* Rydb. in Bull. Torr. Club 54: 18. 1927.—Sp. lectotypica: *A. tricarinatus* Gray.

The original sect. *Tricarinatae* of *Hamosa* embraced about a dozen species including, with five genuine *Leptocarpi*, some members of sects. *Miselli*, *Vallares*, and even *Inflatii*. Its scope is here reduced to the nucleus of two closely related species, *A. tricarinatus* and *A. bernardinus*, the relationship of which to the more typical *Leptocarpi* can hardly be questioned. They stand apart from the foregoing subsections because of their exactly triquetrous, sharp-angled, glabrous pods which taper downward from near the apex into a joint with the short but always evident stipelike gynophore. For several reasons the *Tricarinati* are an extraordinarily interesting pair of species. In the first place the pods are so much alike that Jepson (1936, p. 370) was unwilling to admit the existence of two nearly sympatric species, even though these differ very greatly in ecology, habit of growth, and especially in the form and size of the individual flower. Their ranges are contiguous and even overlap slightly in the Little San Bernardino Mountains, but they are ordinarily separated by altitude and life-zone, *A. bernardinus* forming part of plant-associations dominated by piñon, Joshua-tree, or *Salvia Dorrii* (Kell.) Abrams while *A. tricarinatus* is commonly accompanied by *Larrea*, *Fouquiera*, or *Encelia farinosa* Gray, and the locally endemic *Lepidospartum squamatum* var. *Palmeri* (Gray) Wheeler. Even in their respective associations the species play somewhat different roles. In the White-water region where I have seen it, *A. tricarinatus* commonly occurs in open places, sometimes sheltering against a half-buried boulder, but standing out in well-furnished clumps independent of surrounding vegetation. By contrast *A. bernardinus* is a shy, weak-stemmed plant, encountered nearly always as a straggling herb entangled in the twigs of low, spinose, desert shrubs, which no doubt afford protection from jack-rabbits and shade during the tender seedling stage. The flower of *A. tricarinatus* is comparatively large, with decidedly graduated, ochroleucous petals and a broad, bluntly deltoid keel-tip; that of *A. bernardinus* is substantially smaller, with little-graduated, more abruptly and further recurved petals veined or suffused with purple, and a narrowly triangular, acute keel-tip. With these contrasts in mind it will be profitable to consider the enigmatic similarity in certain details which each of the *Tricarinati* bears to another, again nearly sympatric astragalus of a seemingly completely different type.

The western range-limit of *A. tricarinatus* in the upper Coachella Valley lies just to the east of Whitewater Pass, at a point no more than seven or eight miles distant from the first easterly outpost of *A. pachypus* in Lamb's Canyon near Banning. The latter species, represented in cismontane Riverside County by the endemic var. *Jaegeri*, is quite like *A. tricarinatus* in habit of growth, in leaflets silvery above and greenish beneath (although much narrower and longer), and in the almost identically shaped and proportioned flower of a clear lemon-yellow; but the pod is technically very different, truly stipitate, persistent on the raceme until dehiscence, fleshy becoming ligneous in texture, and finally bicarinate by salient cordlike sutures. The dispersal of *A. bernardinus*, as shown on the map, is bicentric (so far as known), with a center of abundance in the Little San Bernardino Mountains and vicinity, and scattered stations far eastward along the Nevada border. Between these centers, in the central Mohave Desert, one encounters very locally in environment apparently suitable to *A. bernardinus* (Joshua-tree forest) the singular monotype *A. Jaegerianus*. In this *astragalus* are combined the weak, straggling growth-habit and almost exactly the small, purplish flower with beaked keel of *A. bernardinus* and a pod again essentially like that of *A. pachypus* only pendulous. Surely more than blind chance has been involved in the genesis of these specialized organisms. Considered collectively, the four species seem to represent recombinations of morphological characters derived from quite different sources in the genus, one piptoloboid, the other emmenoloboid, and in this quartet there may be an example of a truly reticulate phylogeny. Study of the *Tricarinati* may throw light on at least one method of species-formation in *Astragalus*.

Key to the Species of Subsect. *Tricarinati*

1. Stems 0.5–2.5 dm. long; principal (lower) *peduncles* 9–20 cm. long, arising from near or below the middle of the stem and together with the raceme-axis as long or longer than the stem; *leaflets* (17) 19–25; *flowers* large, the ochroleucous petals graduated, the banner 12.6–15.7 mm., the keel 9.7–11 mm. long, its tip bluntly deltoid; *calyx-tube* 4.1–5 mm. long, 3.5–4.4 mm. in diameter. 321 *A. tricarinatus*
1. Stems 1.5–5 dm. long; *peduncles* 3–10 cm. long, arising from above the middle of the stem and together with the raceme-axis much shorter than the stem; *leaflets* (7) 11–17 (19); *flowers* smaller, the lilac- or purplish-tinged petals little graduated, the banner 7.1–10.2 mm., the keel 6.8–9.4 mm. long, its tip sharply triangular; *calyx-tube* 2.7–4.1 mm. long, 2.3–3 mm. in diameter. 322. *A. bernardinus*

321. *ASTRAGALUS TRICARINATUS*

Low, vigorous, loosely tufted, with a woody taproot and at length suffruticose caudex, strigulose nearly throughout with straight, appressed, filiform or largely flattened and sometimes scalelike hairs up to 0.4–0.5 (0.7) mm. long, the stems thinly so, the leaflets strikingly bicolored, sparsely pubescent and yellowish-green beneath, silvery-canescens above; *stems* several or numerous, erect and ascending in clumps, 5–20 (25) cm. long, stiff, becoming stramineous and striate, simple or few-spurred below, zigzag distally, floriferous from near or commonly from below the middle; *stipules* membranous becoming papery, deltoid or triangular-acuminate, 1–4 mm. long, about semiamplexicaul, thinly pubescent or glabrate dorsally; *leaves* widely spreading or ascending, 7–20 cm. long, shortly petioled, with (17) 19–25 (27) distant, often scattered, ovate, elliptic, or obovate, sometimes obcordate, retuse or obtuse leaflets 3–12 mm. long, readily deciduous from the stiff, ventrally flattened but not sulcate, long-persistent rachis; *peduncles* erect and ascending, 9–20 cm. long; *racemes* loosely (5) 7–12 (15)-flowered, the flowers widely spreading-ascending, the axis elongating, (4) 6–18 cm. long in fruit; *bracts* membranous, ovate or broadly lanceolate, 1–2.4 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 1–2.6 mm., in fruit thickened, 1.8–4.8 mm. long; *bracteoles* commonly 2, minute, or 0; *calyx* 6.1–7.6 mm. long, strigulose with black, mixed black and white, rarely all white hairs, the subsymmetric disc 1.2–1.5 mm. deep, the broadly campanulate, pallid tube 4.1–5 mm. long, 3.5–4.4 mm. in diameter, the subulate teeth 2–2.8 mm. long, the whole becoming papery, marcescent unruptured; *petals* ochroleucous, immaculate; *banner* recurved through $\pm 45^\circ$, ovate- or suborbicular-cuneate, openly notched, 12.6–15.7 mm. long, 7–10 mm. wide; *wings* 11–14.1 mm. long, the

claws 5–6 mm., the broadly oblanceolate or half-obovate, obtuse or commonly erose-emarginate, nearly straight blades 7.1–9.6 mm. long, 2.8–3.6 mm. wide; keel 9.7–11 mm. long, the claws 5–5.6 mm., the half-obovate or lunately elliptic blades 5.5–6.2 mm. long, 2.6–3.2 mm. wide, abruptly incurved through 95° to the bluntly deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* ascending, sessile on a stout gynophore (0.8) 1.2–2.5 mm. long, the body linear-oblanceolate in profile, gently incurved, 2.4–4.2 cm. long, 3.5–5.5 mm. in diameter, triquetrously compressed, sharply carinate ventrally by the prominent, thick, narrowly winged suture, the lateral angles narrow but obtuse, the lateral faces low-concave or nearly plane, the scarcely narrower dorsal face shallowly and openly sulcate, the thin, pale green, glabrous valves becoming papery, stramineous, lustrous, finely reticulate, inflexed as a nearly complete septum 1.5–2.1 mm. wide; *ovules* 20–24; *seeds* brown or purplish-brown, minutely pitted, scarcely lustrous, 2.6–3.3 mm. long.—Collections: 10 (i); representative: *Munz & Johnston 5196* (CAS); *Ewan 3096* (POM); *Ripley & Barneby 3197* (RSA).

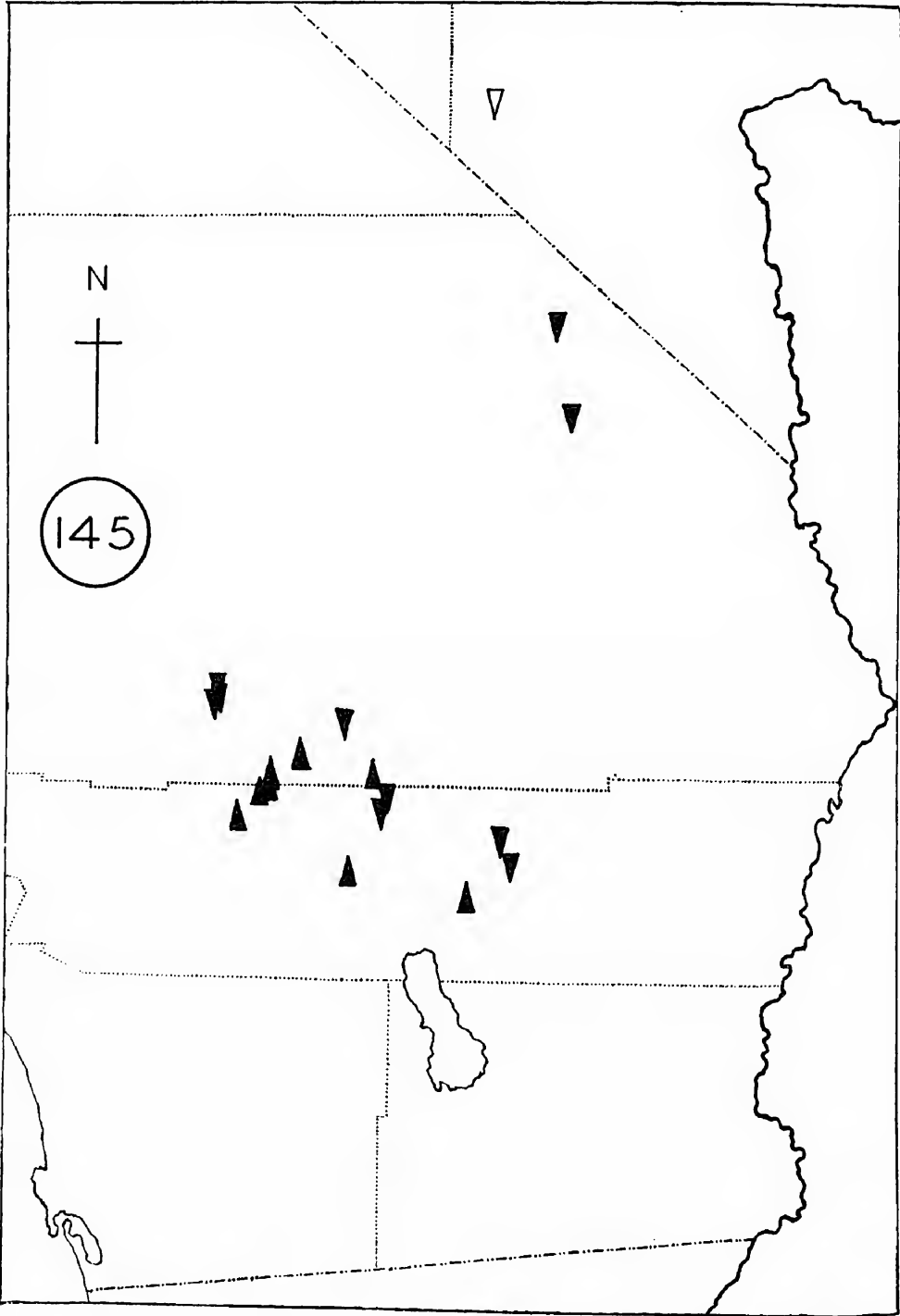
Hot, rocky slopes in canyons and along the edge of boulder-strewn desert washes, with *Larrea* and *Encelia farinosa*, between 1500 and 1850 feet, extending rarely upward into the Joshua-tree forest to 4000 feet, forming colonies but local, known only from around the north end of Coachella Valley, from Whitewater and Morongo Wash across the south face of the Little San Bernardino Mountains to the Orocopia Range, in central Riverside and adjoining San Bernardino Counties, California.—Map No. 145.—February to May.

ASTRAGALUS TRICARINATUS (three-keeled, of the fruit) Gray in Proc. Amer. Acad. 12: 56. 1876.—“White Water, San Bernardino Co., California, Parry, 1876.” Holotypus (*Parry 2*, dated “1873”), GH! probable isotypi, NY (*Parry & Lemmon in 1876*), K (*No. 88*)!—*Hamosa tricarinata* (Gray) Rydb. in Bull. Torr. Club 54: 20. 1927.

The three-keeled milk-vetch, *A. tricarinatus*, is a handsome and easily recognized astragalus, notable particularly for the many small leaflets of broad outline, silvery-pubescent above and greenish beneath, disposed in distant pairs or more commonly scattered along a stiff rachis, from which they disjoint readily on drying. The shortness of the stems in relation to the long, stout peduncles is another unusual feature. As mentioned in the foreword to the subsection, the flower and inflorescence of *A. tricarinatus* are very similar to those of *A. pachypus*; and by confusion of flowering specimens of the two species, the three-keeled milk-vetch has been reported (Jones, 1923, p. 259; Jepson, 1936, p. 370) as extending north to the head of San Joaquin Valley in Kern County. Even at anthesis *A. pachypus* may be distinguished by its narrower, linear or linear-oblong leaflets; and its truly stipitate, laterally flattened, two-keeled pod of almost woody texture is unmistakable. The whole range of *A. tricarinatus*, extending from the Morongo Wash region to the hills northeast of Mecca, has a diameter of about fifty miles.

322. *ASTRAGALUS BERNARDINUS*

Slender, wiry, sparsely leafy, with a woody taproot and knotty root-crown or ultimately a twiggy, suffruticose caudex, strigulose with rather stiff, straight, filiform or flattened, appressed hairs up to 0.35–0.5 mm. long, the stems often thinly so, the herbage greenish or subcanescent, the leaflets pubescent on both sides, commonly more densely so above than beneath; *stems* several or numerous, ascending, weak and flexuous when sheltered, stiff and zigzag in open places, (1) 1.5–5 dm. long, simple or usually branched at 1–3 nodes preceding the first peduncle, the branches sometimes again branched, together forming low, tufted clumps; *stipules* submembranous becoming papery, greenish, pallid, or purple-tinged, ovate or deltoid, (1) 1.5–4 mm. long, semi- or the lowest almost fully amplexicaul; *leaves* (3) 4–12 (14) cm. long, petiolate but the uppermost quite shortly so or subsessile, with rather stiff rachis and (7) 11–17 (19) rather distant, narrowly to broadly lanceolate or oblong-elliptic, obtuse or retuse, flat or folded



Map No. 145. Southeastern California. Range of *A. bernardinus* (◄ a doubtful station); and of *A. tricarinatus*.

leaflets (3) 5–20 (25) mm. long; *peduncles* erect or incurved-ascending, (1.5) 3–10 cm. long, shorter than the leaf; *racemes* loosely 10–25-flowered, the flowers ascending at full anthesis, sometimes spreading in age, the axis elongating, (2.5) 4–15 (17) cm. long in fruit; *bracts* membranous, ovate or ovate-acuminate, 1–1.7 mm. long; *pedicels* straight or nearly so, ascending, at anthesis slender, 0.4–0.7 mm. long, in fruit thickened, 1–2 mm. long; *bracteoles* usually 2, minute, sometimes 0; *calyx* 3.6–6.7 mm. long, strigulose with mixed black and white or almost all black hairs, the asymmetric disc 0.6–1 mm. deep, the submembranous, pallid or purplish tube 2.7–4.1 mm. long, 2.3–3 mm. in diameter, the subulate teeth 0.9–3 mm. long, the whole becoming papery, persistent unruptured; *petals* little graduated, pale or dark lilac, drying bluish, sometimes whitish lined and distally suffused with pinkish-lilac; *banner* abruptly recurved through 45–80°, broadly rhombic-ovate-cuneate, sometimes subflabellate, openly notched, 7.1–10.2 mm. long, 5.5–8.1 mm. wide; *wings* (0.2 mm. shorter, rarely a trifle longer than the banner) 7–9.6 mm. long, the claws 3.1–4.9 mm., the narrowly oblong-oblan-ceolate, subtruncate or obscurely emarginate, strongly incurved blades 4.2–6.3 mm. long, 1.6–2.7 mm. wide, the inner margins of both infolded; *keel* (1 mm. shorter to 0.3 mm. longer than the wings) 6.8–9.4 mm. long, the claws 3.1–4.8 mm., the broadly lunate-triangular blades 3.7–5.5 mm. long, 2.3–3.1 mm. wide, abruptly incurved through 95–100° to the sharply triangular, often slightly por-rect apex; *anthers* (0.45) 0.5–0.65 mm. long; *pod* erect or incurved-ascending at a narrow angle, sessile on a stout gynophore 0.7–1.5 mm. long, the body nar-rowly oblanceolate in profile, nearly straight or gently incurved (often more so in the lower $\frac{1}{3}$ than distally), (2) 2.5–3.1 cm. long, 3.7–5 mm. in diameter, grad-ually tapering toward the base, abruptly triangular-acute at apex, triquetrously compressed, sharply carinate ventrally by the suture, the lateral angles narrow but obtuse, the lateral faces flat or low-concave and only slightly broader than the shallowly sulcate or ultimately flat dorsal face, the thin, pale green or purple-tinged, glabrous and (when fresh) glaucescent valves becoming papery, stramin-eous, delicately cross-reticulate, inflexed as a complete septum 2–3 mm. wide; *ovules* 19–28; *seeds* not seen.—Collections: 9 (ii); representative: *Munz 13,000* (CAS, POM), *13,748* (POM, WS), *17,347* (NY, OKLA, POM); *Barneby 11,362* (CAS, NY, POM, RSA).

Gravelly washes and rocky mesas, in granitic or rarely calcareous soils, com-monly taking shelter under and entangled in low desert shrubs, 3000–6700 feet, locally plentiful in scattered stations, mountains of southern and eastern Mohave Desert (east base of San Bernardino, Little San Bernardino, New York, and Ivanpah Mountains) in eastern Riverside and San Bernardino Counties, Cali-fornia.—Map No. 145.—April to June.

ASTRAGALUS BERNARDINUS (of San Bernardino Mts.) Jones in Proc. Calif. Acad. Sci. II, 5: 661. 1895 ("*Bernardinus*").—"Moronyo King Mine, east side of San Bernardino Mountains, California, 5000° alt., June 16, 1894, Parish."—No holotypus found (1960) at US! phototypus (of plant supposedly at US) + fragments, POM! isotypus, *Parish 3001*, DS! paratypus, *Parish 2581* collected in 1892, labeled by Jones "part of type," GH!—*Hamosa bernardina* (Jones) Rydb. in Bull. Torr. Club 54: 19. 1927.

The lesser three-keeled milk-vetch, *A. bernardinus*, is an unassuming, rather weedy astraga-lus which reveals the beauty of its lilacine or dingily purple flower and smooth, three-sided, glaucescent pod only to the close scrutiny of the curious. In the sagebrush belt of the Great Basin there are several astragali belonging to different groups which are intimately associated with the sagebrush bush itself or with others of similar form and habit, seeming to require their shelter during the seedling stage. During the first season the young plant is concealed and pro-ected by its host, and when mature displays flowers and fruits at the level of its topmost twigs. In the Mohave Desert milk-vetches of this type are few and rare, the others beside *A. ber-nardinus* being very local, *A. Jaegerianus* endemic to mesas north of Barstow and *A. atratus*

var. *mensanus* to the Death Valley region. Both of these have pendulous pods laterally flattened and persistent on the receptacle, in the former stipitate and carinate by both sutures, in the latter sessile and narrowly grooved along the back.

LXXIX (vi). Subsectio CALIFORNICI

Slender, erect or diffuse annuals (*A. Emoryanus* exceptionally biennial); *vesture* basifixed; *leaflets* 5–21 (23); *flowers* 1–10 (12), loosely but sometimes quite shortly or subumbellately racemose, spreading or finally declined, small, the banner about 4.5–12 mm. long; *calyx-tube* campanulate (1.6–3.5 mm. long, 1.3–2.8 mm. in diameter); *petals* regularly or irregularly graduated, the keel either shorter or longer than the wings, either obtuse or acute at apex; *pod* erect, ascending, or deflexed (in 2 spp. resupinate on twisted pedicels), sessile on and early disjointing from the receptacle or short gynophore, varying in profile from linear-oblong or -lanceolate to lunately linear-elliptic, rarely plumply lance-oblong (in *A. Breweri* plumply ovoid-fusiform and contracted distally into a long-subulate beak), straight or incurved, more or less triquetrous, dorsally sulcate, bilocular; *dehiscence* apical and basal (perhaps sometimes apical only) and sometimes through the septum, after falling; *ovules* (2) 4–26.—Spp. 9, xerophytes (*A. tener* of vernal moist but summer-dry soils), of cismontane and desert California and Baja California, southern Nevada, and (1 only) extending from northern Arizona through New Mexico to arid southern and trans-Pecos Texas and northern Mexico.

ASTRAGALUS sect. LEPTOCARPI subsect. CALIFORNICI (Gray), comb. nov., based on *Astragalus* sect. *Oroboidei* subsect. *Californici* Gray in Proc. Amer. Acad. 6: 206. 1864.—Sp. lectotypica: *A. tener* Gray.

Astragalus sect. *Spiesiodes* Sheld. in Minn. Bot. Stud. 1: 117. 1894.—Sp. lectotypica: *A. acutirostris* Wats.

Hamosa sect. *Acutirostres* Rydb. in Bull. Torr. Club 54: 330. 1927.—Sp. manifeste typica: *H. acutirostris* (Wats.) Rydb. = *A. acutirostris* Wats.

Astragalus sect. *Breweriani* Rydb. in N. Amer. Fl. 24: 454. 1929.—Sp. unica: *A. Breweri* Gray.

Features of the *Californici* significant in the context of the section are the annual root, shallowly campanulate calyx-tube, and deciduous pod dehiscent only on falling. They are perhaps artificially separated from the genuine *Leptocarpi* from which they differ technically in the disjointing fruit alone; and with scarcely better reason from subsect. *Pringleani* by the root of shorter duration and shallower calyx-tube. The members of the subsection fall into two groups, one inhabiting the deserts of California and arid southwestern United States and Mexico, the other of cismontane and coastal California. The latter are greenish, thinly pubescent plants with submembranous stipules glabrous or nearly so dorsally and pods for the most part quite bluntly trigonous, with rounded lateral angles, yielding an obcordate section. The desert species, with stems, stipules, and foliage often cinereously pubescent, have fruits more strongly compressed laterally, narrowly triangular or inversely Y-shaped in section. However, the lines between the groups are not clearly drawn. Thus the pods of cismontane *A. pauperculus* and transmontane and Lower Californian *A. acutirostris* scarcely differ in form or compression and share, moreover, the peculiar attribute of being as often as not resupinate by torsion of the pedicel. Unless appearances are deceptive, this pair of species must be closely related and serves to connect the desert and coastal groups.

The species are arranged so far as possible in what seems to be an ascending order of specialization. The transmontane *A. Emoryanus*, ordinarily an annual of a few months duration but occasionally persisting into a second year, is the least specialized and most nearly suggestive of *A. nothoxys* and *A. Pringlei* of the first subsect. *Pringleani*. The cismontane *A. Clarianus*, with its irregularly graduated petals and pod elevated on a gynophore, and the nearly sympatric *A. Breweri*, with its greatly modified fruit, represent terminal evolutionary stages.

The subsection *Californici* was based originally on *A. Breweri* and *A. tener*, of which the fruits and, in consequence, the natural affinities were imperfectly known. The species familiar to Jones were included (1923, p. 266–271) in his section *Leptocarpi* and maintained by Rydberg (1927, p. 321, sequ.) in a homonymous section of *Hamosa*. Both the sections *Spiesiodes*

and *Acutirostres* listed in the synonymy were based on the two species *A. nothoxys* and *A. acutirostris*, the keel-petals of which are acute at tip and had been described as simulating those of *Oxytropis* DC. or *Spiesia* Neck. An acute keel-tip has evidently been evolved separately in several lines of inheritance in sect. *Leptocarpus* (cf. *A. arizonicus*, *A. Gentryi*, and *A. Nuttallianus* vars. besides the two already mentioned) and a group defined by this single peculiarity is not a natural one. On account of the pod, the body of which is greatly shortened but is almost certainly derived from one of a more generalized type, such as is found in its sympatric relatives in cismontane California, *A. Breweri* has been excluded from the *Lectocarpus* in the past and referred by Jones to sect. *Didymocarpus* and by Rydberg to a monotypic sect. *Breweriani* in "genuine" *Astragalus*, i.e., the nucleus remaining after his many segregate genera had been taken out. Gray's original disposition of *A. Breweri* seems much more natural.

Key to the Species of Subsect. Californici

1. Plants of the deserts of s.-e. California, s. Nevada, s. and e. to s. Baja California, s. Texas, and Nuevo León (2)
 2. Ovary and pod glabrous; *keel-tip* bluntly deltoid; Texas and New Mexico to Nuevo León and isolated in n.-w. Arizona 323. *A. Emoryanus*
 2. Ovary and pod pubescent (if exceptionally glabrous the *keel-tip* acutely triangular); s. Nevada and s.-e. California to Baja California (3)
 3. Leaflets 13–19 (23); *racemes* (4) 5–12-flowered; *flowers* relatively large, the calyx 4.6–6.2 mm., the banner about 8–11 mm., the keel 5.5–9.3 mm. long; *pod* ascending, straight or nearly so; s. Baja California, s. Sonora, and Sinaloa (4)
 4. Keel about 5.5–6 mm. long, bluntly deltoid at apex, much shorter than the wings and banner; *ovules* 8–12; Cape region, Baja California 326. *A. francisquitensis*
 4. Keel about 7–9 mm. long, narrowly triangular, acute and porrect at apex, equaling or a little surpassing the wings, little shorter than the banner; *ovules* 13–18; Sonora and Sinaloa; cf. *A.* (subsect. *Pringleani*) *Gentryi*
 3. Leaflets 7–13 (15); *racemes* 1–6-flowered; *flowers* smaller, the calyx 2.8–4 mm., the banner 4.2–7 mm., the keel 3.7–5.8 mm. long; *pod* variably oriented, usually arcuate, if ascending usually humistrate; s. Nevada to n. district of Baja California (at about 30° N.) (5)
 5. Blades of the keel 1.6–2.5 mm. long, half-obovate, bluntly deltoid at apex; *pod* declined, evenly incurved through $\frac{1}{4}$ – $\frac{1}{2}$ circle, hirsutulous with spreading hairs over 0.5 mm. long; s. Nevada, local 324. *A. nyensis*
 5. Blades of the keel (3) 3.2–3.8 mm. long, lunately half-elliptic, acutely triangular at apex; *pod* variably oriented, very gently incurved, minutely strigulose or exceptionally glabrous; widespread over the deserts in the range given 325. *A. acutirostris*
 1. Plants of cismontane California (North Coast Ranges, Great Valley, lower Salinas Valley, and along the coast from Monterey to San Diego) (6)
 6. Pod seed-bearing near the middle, narrowly oblong or linear in profile, not spinose-beaked or, if somewhat so, then the beak not over $\frac{1}{2}$ as long as the body (6)
 7. Keel shorter than the wings, the blades 2.1–5.5 mm. long, 1.3–2.4 mm. wide; *pod* variable in shape, but sessile on the flat or scarcely produced receptacle (7)
 8. Pod 6–20 mm. long, rounded at base; Great Valley and along the immediate coast from Monterey to San Diego (8)
 9. Racemes loosely 2–5 (7) flowered, the axis elongating and mostly 7–20 mm. long in fruit; *pod* brightly mottled or uniformly suffused with purple, often resupinate on contorted pedicels; upper Sacramento Valley and foothills to the e., 450–2050 ft. elevation 328. *A. pauperculus*
 9. Racemes subcapitate, the fruiting axis not over 0.8 mm. long, if over 5 mm. long the flowers 7 or more; *pod* green turning stramineous; low alkaline meadows and depressions along the coast, mostly below 200 ft., lower Sacramento Valley, s.-ward 327. *A. tener*
 8. Pod (15) 18–57 mm. long, if less than 21 mm. long then cuneately tapering or substipitate at base; N. Coast Ranges and lower Sacramento Valley 329. *A. Rattani*
 7. Keel very large and prominent, as long or up to 1.6 mm. longer than the narrow wings, the blades 5.7–7.2 mm. long, 2.8–3.5 mm. wide; *pod* linear, acuminate at both ends, both substipitate at base and elevated from the receptacle on a slender gynophore 1.4–2.5 mm. long; local in Napa and Sonoma Counties 330. *A. Clarianus*

6. Pod seed-bearing only in the lower half, differentiated into an ovoid or oblong-fusiform, silvery-strigulose body about 5–10 mm. long, abruptly contracted into a glabrescent, spinelike beak of nearly the same length; North Coast Ranges, Mendocino and Lake to Marin County 331. *A. Breweri*

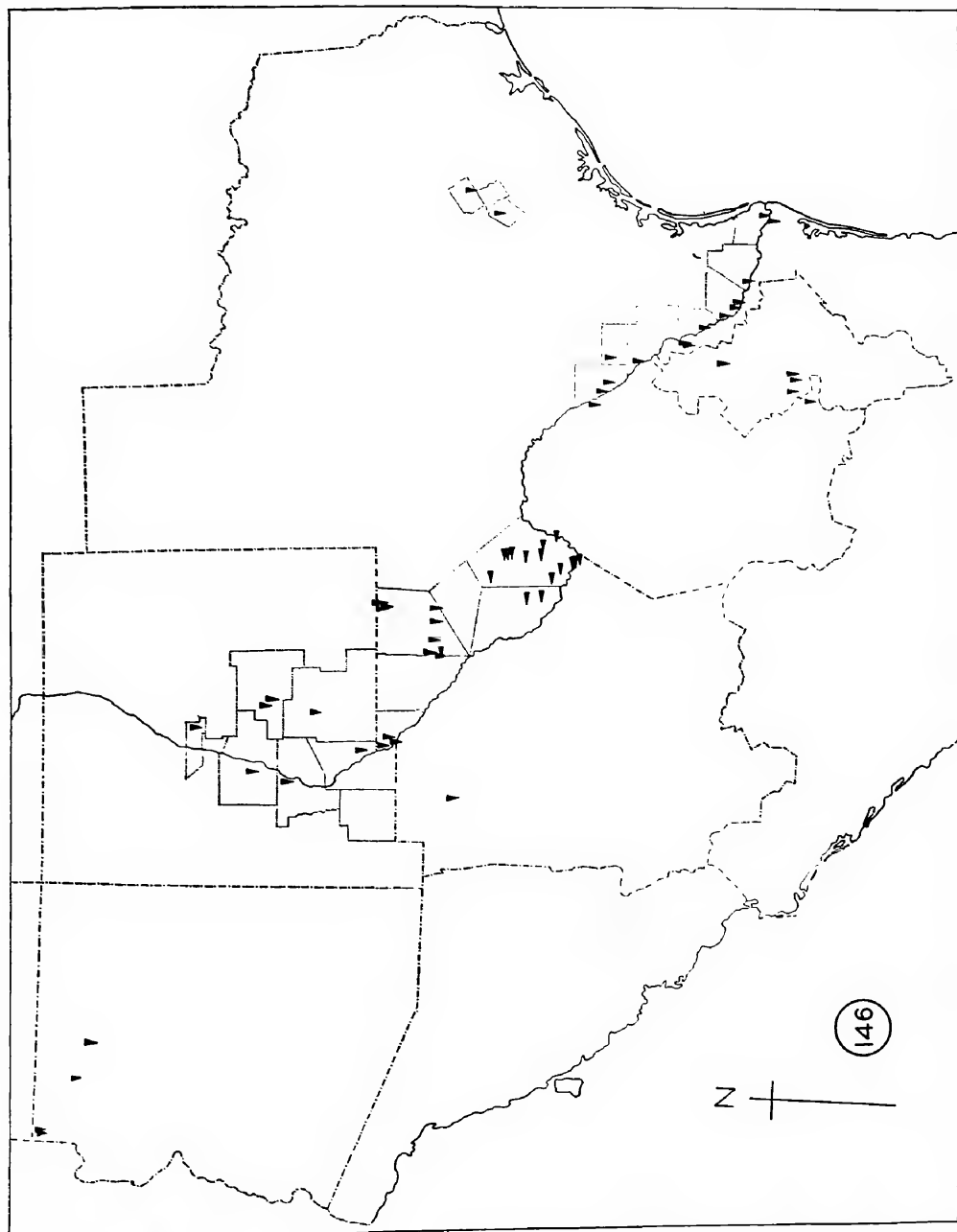
323. *ASTRAGALUS EMORYANUS*

Annual or winter-annual, exceptionally persisting into a second year, diffuse or prostrate, densely to quite thinly strigulose, hirsutulous, or subvillosulous with appressed, incurved-ascending, or more rarely rather stiffly spreading hairs up to 0.5–0.75 (1.05) mm. long, the herbage silvery-cinereous or sometimes greenish, the leaflets commonly pubescent on both sides, but sometimes only marginally or quite glabrous above; *stems* 3–several or very numerous, radiating from the root-crown, (0.25) 0.4–4.5 (6) dm. long, branched or spurred below, floriferous upward from near or below the middle, together forming loosely or quite densely woven mats; *stipules* 1.5–3.5 (5.5) mm. long, deltoid, ovate, or triangular, membranous or membranous-margined, subglabrous dorsally, semi- or the lowest sometimes almost fully amplexicaul; *leaves* 1–4.5 (8) cm. long, all shortly petioled or the uppermost subsessile, with (7) 11–19 (21) often rather crowded, oval-obovate, obcordate, broadly cuneate-oblancheolate, or sometimes mostly elliptic-oblancheolate, obtuse or retuse, loosely folded or flat leaflets 2–10 (14) mm. long; *peduncles* slender, mostly (1) 2–6 (10) cm. long and as long or longer than the leaf, but some early ones (or exceptionally all) much shorter and few-flowered; *racemes* shortly but loosely (1) 2–10 (12)-flowered, the flowers spreading or finally declined, the axis little elongating, (0) 0.3–2.5 (3.5) cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 0.5–1.8 mm. long; *pedicels* at anthesis ascending, (0.5) 0.7–1.8 mm. long, in fruit arched outward, a little thickened, (0.6) 1–2 mm. long; *bracteoles* 0 (exceptionally a minute scale); *calyx* 3.6–6 mm. long, pubescent like the herbage with white, mixed black and white, or nearly all black hairs, the subsymmetric disc (0.4) 0.5–1.1 mm. deep, the membranous, pallid or purplish, campanulate tube 1.9–3.5 mm. long, (1.5) 1.7–2.5 (2.8) mm. in diameter, the subulate or lance-subulate teeth 1.3–2.5 (2.9) mm. long; *petals* pink-purple, the banner with a large, pallid, striate eye in the fold; *banner* recurved through $\pm 45^\circ$, obovate-, ovate-cuneate, or flabellate, widely and sometimes deeply notched, (6) 7.3–11.2 mm. long, (3.1) 5.3–9.5 mm. wide; *wings* (5.1) 6.2–8.8 (10) mm. long, the claws (1.8) 2–3 mm., the oblong-oblancheolate, -obovate, or narrowly oblong, obtuse or obscurely emarginate blades (3.2) 3.7–6.6 (8) mm. long, (1.1) 1.7–3.4 mm. wide; *keel* (4.5) 4.8–6.6 mm. long, the claws (1.9) 2.2–3.3 mm., the half-obovate or -circular blades (2.3) 2.6–3.6 (4) mm. long, (1.5) 1.9–2.5 mm. wide, rather abruptly incurved through $90\text{--}100^\circ$ to the bluntly deltoid apex; *anthers* (0.25) 0.3–0.5 mm. long; *pod* spreading, declined, or (when humistrate) ascending, linear-oblong or narrowly lance-oblong in profile, incurved gently and evenly through $\frac{1}{4}\text{--}\frac{1}{2}$ circle or (when short) lunately incurved to almost straight, 0.8–2.2 cm. long, (2) 2.2–4.3 mm. in diameter, obtuse at base, shortly cuspidate at apex, triquetrously compressed with low-convex lateral and openly sulcate dorsal faces, the green or purple-tinged, glabrous valves becoming papery, pale brown or stramineous, delicately reticulate, inflexed as a complete or nearly complete septum 1.2–2 mm. wide; *ovules* (8) 10–15 (17); *seeds* compressed-quadrangular, brown or olivaceous sometimes dotted with purple, smooth or somewhat pitted, (1.8) 2–2.9 mm. long.

The Emory milk-vetch is the only species of its subsection known to occur east and south of the Colorado River; it is confined (except for outposts in northwestern Arizona) to New Mexico, Texas, and northern Mexico, where it can be confused only with the small-flowered genuine *Leptocarpi*, *A. leptocarpus* itself, and forms of *A. Nuttallianus* with glabrous ovary

and fruit. These are distinguished ideally by their persistent pods which turns black on drying, and at anthesis, in most instances, by the triangular-acute keel-tip, the hispid-ciliate calyx-teeth, or leaflets of some leaves elliptic and subacute, not all truncate-retuse. Only some phases of *A. Nuttallianus* var. *macilentus* found on the Edwards Plateau in westcentral Texas have all these points in common with *A. Emoryanus*, and it is only in this comparatively small area that well-formed pods, showing the characteristic incipient stipe of var. *macilentus* or the rounded base of the present species, are required for identification.

Notable features of *A. Emoryanus* are its wide climatic tolerance, apparent indifference to type of bedrock, and pattern of dispersal very largely confined to the valley of the Rio



Map No. 146. Arizona, New Mexico, Texas, and parts of northern Mexico. Range of *A. Emoryanus*: ➤ var. *Emoryanus*; and ♦ var. *terlinguensis*.

Grande, along which it descends from nearly 7000 feet elevation near Albuquerque to the Gulf Coast. In all probability the foregoing description conceals several distinguishable geographic races, but only one of them, strongly marked by an abrupt shortening of the pod analogous to that found in *A. Pringlei* as compared with *A. nothoxys*, stands out with sufficient clarity to deserve recognition for the present.

Key to the Varieties of *A. Emoryanus*

1. Pod linear-oblong, very gently to strongly but then evenly incurved, 1.2–2 (2.2) cm. long, (2) 2.2–3.3 mm. in diameter, 5–6.5 times as long as its diameter; range of the species 323a. var. *Emoryanus*
1. Pod more broadly and plumply lance-oblong, nearly straight or very slightly incurved, 0.8–1.4 cm. long, (2.5) 3–3.7 mm. in diameter, 3–4.5 times as long as its diameter; local in trans-Pecos Texas 323b. var. *terlinguensis*

323a. *ASTRAGALUS EMORYANUS* var. *EMORYANUS*

Peduncles homomorphic or nearly so, all equaling or surpassing the leaf; *vesture* mostly appressed or subappressed, distinctly shorter than that of var. *terlinguensis* where the two varieties coincide in range; *pod* as given in the key.—Collections: 52 (v); representative: *Wootton* 3842, 3870 (NMC); *Earle* 589 (NY); *Ripley & Barneby* 4212 (RSA), 11,146 (CAS, NY, RSA, US); *Jones* 28,191 (CAS, POM), 29,319 (MO, POM); *E. J. Palmer* 11,686 (NY); *Johnson & Barkley* 16,243 (GH, NY, TEX); *Webster & Barkley* 13,504 (TEX), 13,504A (MO).

Dry stony hillsides, canyons, sandy flats and washes, gravel bars of intermittent streams, sometimes in disturbed soil along highways, strongly but not exclusively calciphile, locally plentiful in the Rio Grande Valley and adjoining hill-country in southern New Mexico and trans-Pecos Texas, where associated with *Larrea*, mesquite-grassland, or juniper forest between 2000 and 5600 (6000) feet, extending north and up to 7000 feet in the Sandia Mountains into north-central New Mexico, south to northern Chihuahua, and descending southeast and down to 100 feet in scattered stations on both banks of the Rio Grande to the Gulf Coast in southern Texas and Tamaulipas, and south to the foothills of the Sierra Madre Oriental in Nuevo León and southeastern Coahuila; apparently greatly isolated in northwestern Arizona (Grand Canyon of the Colorado River; near Beaver Dam).—Map No. 146.—February to June.

ASTRAGALUS EMORYANUS (Rydb.) Cory in *Rhodora* 38: 406. 1936, based on *Hamosa Emoryana* (William Hemsley Emory, 1811–1887, Lieutenant U. S. Army, in command of one of the Mexican Boundary Survey parties) Rydb. in *Bull. Torr. Club* 54: 237. 1927.—“Wright also collected well-developed specimens at El Paso (no. 1359). This number as represented in the Torrey Herbarium I have taken as the type.”—Holotypus, collected by Charles Wright in 1852, NY! isotypi, GH, MO!

Hamosa montereyensis (of Monterrey, Nuevo León) Rydb. in *Bull. Torr. Club* 54: 326. 1927.—“The type was collected at Monterey, Nuevo Leon, February 1880, *Palmer* 237 (Gray Herbarium).”—Holotypus, GH!

The typical form of the Emory milk-vetch is a slender, few-stemmed plant with neat, obovate or obcordate leaflets less than a centimeter long, ashen at least beneath and marginally with subappressed hairs. It is the phase encountered most commonly in New Mexico and far western Texas at middle elevations and recurs, possibly as a result of chance introduction, in the Grand Canyon, Arizona, and in Milam and Bastrop Counties on the coastal plain in east-central Texas. Populations of perennant plants, germinating in fall and flowering in favorable years over a long period lasting from spring into late summer of the ensuing season, occur in the foothills of the Guadalupe Mountains in Culberson County, Texas, and in the White and Sandia Mountains in New Mexico. These eventually form wide mats of freely branching stems beset with an extraordinary profusion of small, gaily colored purple blossoms, at first sight very distinct, but precisely typical in the form of the flower and fruit and, when young or when starved of moisture, reverting to the more ordinary type. Along the lower Rio Grande, largely separated from the foregoing by the Big Bend country where the Emory milk-vetch is repre-

sented by its endemic var. *terlinguensis*, the predominant phase of the species is coarser and leafier and more thinly pubescent with slightly shorter hairs. Plants of this nature from Zapata County (Ripley & Barneby 9050, RSA) grew in moist sand of a creek bed and their unfamiliar appearance was attributed, perhaps wrongly, to the environment; most material from the region is similar and may represent a distinct variety. In Nuevo León and eastern Coahuila there is another seemingly trivial variant of *A. Emoryanus*, distinguished by a flower with wings as long as the banner or nearly so and consequently a certain individual facies. A plant of this sort furnished the typus of *Hamosa montereyensis*. The racial situation in this region deserves attentive study.

The history of *A. Emoryanus* is rather curious, but as it has been told elsewhere in some detail (Barneby, 1956, p. 493) there is place here for only a summary sketch. A common species along the Mexican boundary, it was collected by most of the botanists active in the Rio Grande Valley in the early days of exploration, but was consistently confused with sympatric forms of *A. Nuttallianus*, in the first place by Gray, and by all succeeding students of the genus. Gray's practice of mixing supposedly conspecific materials from different localities and distributing these under a common label promoted subsequent confusion of critical species; the annual astragali collected by Charles Wright and the Boundary Survey parties were mixed in this way, and *A. Emoryanus* was unnecessarily lost to sight for a century. The species was finally described only by accident. It is clear from Rydberg's discussion that the substance of his *Hamosa Emoryana* was almost wholly the glabrous-fruited variant of *A. Nuttallianus* var. *austrinus*, although the specimen that he selected as holotypus is the species treated here. Despite the contradictions involved, the name remains attached in *Astragalus* to the precisely specified typus.

323b. ASTRAGALUS EMORYANUS var. TERLINGUENSIS

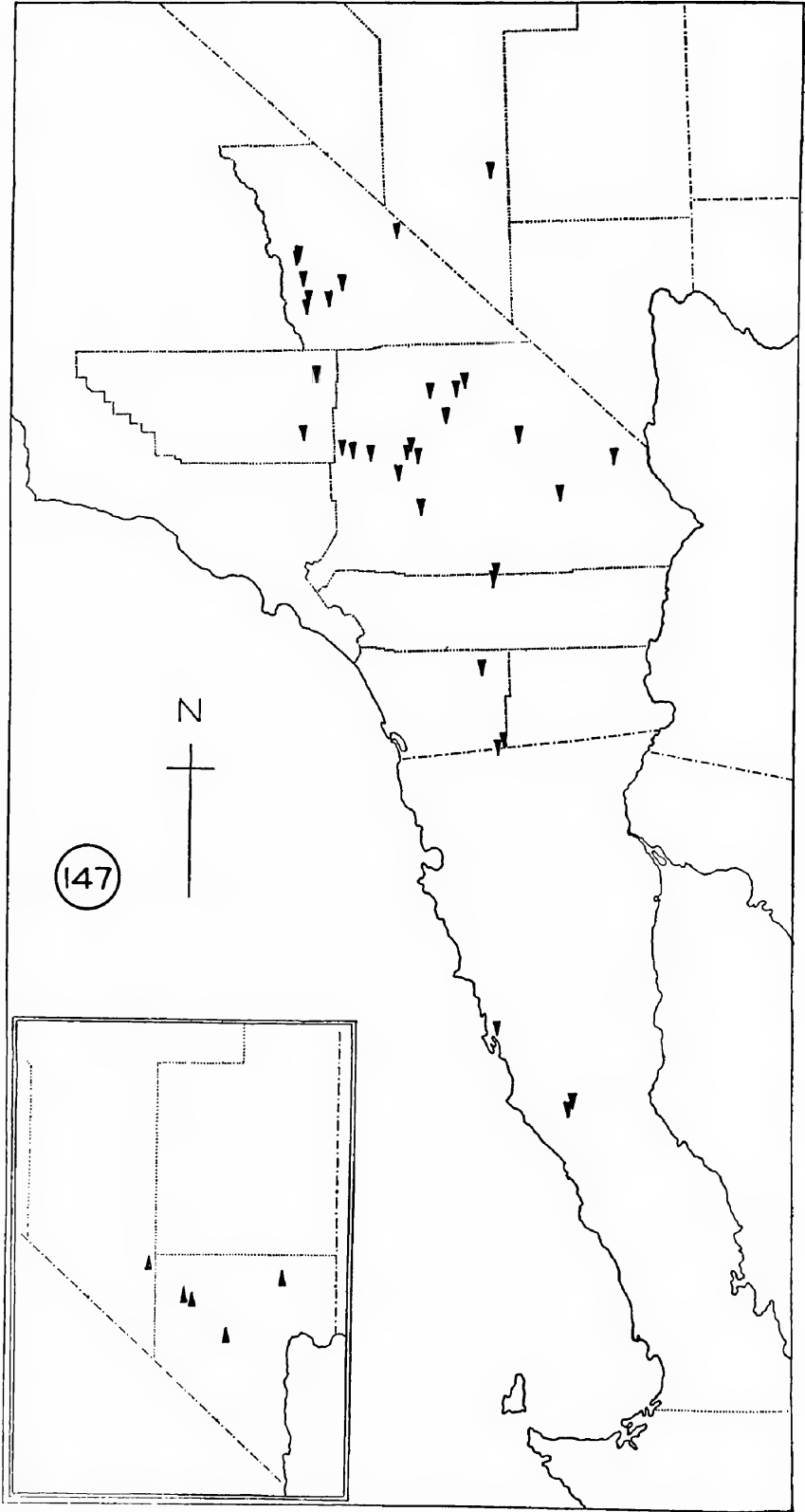
Peduncles mostly dimorphic, the early or lower ones, sometimes all, filiform and only 1.5–30 mm. long, bearing 1–3 (4) flowers, and much shorter than the leaf, the later ones commonly better developed and up to 3–5.5 cm. long; *herbage* cinereously hirsutulous with rather stiff, straight and spreading or incurved-ascending hairs up to (0.5) 0.6–0.75 mm. long; *pod* as given in the key.—Collections: 22 (o); representative: *Warnock* 7656 (SMU, SRSC, WIS, TEX), 47,023 (SMU, SRSC); *McVaugh* 7829 (SMU, SRSC, TEX); *Hinkley* 2346, 2435 (NY).

Dry rocky hillsides and sandy or gravelly washes, 2500–4000 feet, locally plentiful around the Big Bend of the Rio Grande and tributary streams, especially Maravillas and Terlingua Creeks, Brewster County, Texas, and adjoining Coahuila, and (perhaps somewhat isolated) in the Van Horn Mountains, in Culberson and Hudspeth Counties, Texas.—Map No. 146.—February to April.

ASTRAGALUS EMORYANUS var. TERLINGUENSIS (Cory) Barneby in Amer. Midl. Nat. 55: 494. 1956, based on *A. terlinguensis* (of Terlingua Creek) Cory in Rhodora 39: 419. 1937.—“Type: Terlingua Creek above the mouth of Alamo de Caesario Creek (about 18 miles south of Terlingua), 13 April 1936, *Cory* 18584 (Gray Herb.).”—Holotypus, labeled: “Terlingua Creek, 8 miles n. of Terlingua,” the date and number as cited, GH!

The extreme form of the Big Bend milk-vetch, *A. Emoryanus* var. *terlinguensis*, is remarkably distinct from var. *Emoryanus*, the hirsutulous pubescence, short, few-flowered peduncles, transparently membranous fruiting calyx, and especially the short, relatively plump pod all contributing something to its individuality. As pointed out elsewhere (Barneby, 1956, l.c.), the short peduncle is a juvenile character, also found low on the stems of var. *Emoryanus* as well as in several genuine *Leptocarpi* and some species of other groups. I have specimens from Brewster County, furthermore, in which the calyx and vestiture of var. *terlinguensis* are combined on the same plant with the developed peduncles and long pods proper to var. *Emoryanus*, and these seem decisively intermediate between the two forms.

The dispersal of var. *Emoryanus* into two elongate lobes, divided by the Big Bend country and var. *terlinguensis*, forms a pattern unmatched elsewhere in American *Astragalus* and one which is a rarity in the higher plants. It is possible but not very probable that exploration of Coahuila will show var. *Emoryanus* to be distributed more continuously east and west than is known at present. Lacking such evidence, I must suppose that var. *terlinguensis*, the derived and more specialized of the two forms, represents a dominant mutant which has arisen near the center of the species-range and there has almost fully replaced the parental type.



324. ASTRAGALUS NYENSIS

Slender, diffuse, with a subfiliform taproot, hirsutulous throughout with rather stiff, loosely ascending, straight or incurved hairs up to 0.6–0.8 (0.9) mm. long, the herbage greenish-cinereous, the leaflets equally pubescent on both sides or medially glabrescent above; *stems* 1–17 cm. long, the central one erect, not over 2.5 cm. long and somewhat inhibited, with very short internodes, the lateral ones 1–2 from the axils of the cotyledons, prostrate, simple or either spurred or branched at the first 1–2 nodes, composed of about 1–7 developed internodes up to 1.5–3.5 (4) cm. long; *stipules* deltoid or lance-triangular, 1–2.2 mm. long, the lowest papery-membranous, semi- or almost fully amplexicaul, the upper ones narrower, thinly herbaceous, thinly pubescent dorsally; *leaves* 1–4 cm. long, with 7–13 crowded, oblong-obovate, retuse, loosely folded leaflets 2–7 mm. long; *peduncles* 0.3–1.5 (2.5) cm. long, much shorter than the leaf; *racemes* loosely 1–4-flowered, the flowers early declined, the axis 0–1.5 cm. long in fruit; *bracts* membranous, triangular-acuminate, 0.6–1 mm. long; *pedicels* 0.8–1 mm. long, recurved and persistent in fruit; *bracteoles* 0; *calyx* 3–4 mm. long, white-hirsutulous, the symmetrically turbinate disc 0.6–0.7 mm. deep, the submembranous, purplish tube 1.6–2.3 mm. long, 1.3–1.7 mm. in diameter, the firmer, lance-subulate teeth 1.3–2 mm. long; *petals* whitish, the banner faintly lilac-veined; *banner* recurved through $\pm 40^\circ$, ovate- or obovate-cuneate, shallowly notched, 4.2–5.4 mm. long, 2–3 mm. wide; *wings* (3.5) 4–4.9 mm. long, the claws 1.7–2.2 mm., the narrowly oblong-oblancheolate, obtuse, slightly incurved blades (2) 2.5–3.5 mm. long, 0.8–1.3 mm. wide; *keel* 3.7–4.5 mm. long, the claws 1.8–2.2 mm., the half-obovate blades 1.6–2.5 mm. long, 1.1–1.4 mm. wide, abruptly incurved through $90-95^\circ$ to the bluntly deltoid apex; *anthers* 0.25–0.3 mm. long; *pod* declined, linear-oblong in profile, incurved through $\frac{1}{4}-\frac{1}{2}$ circle, 1.3–1.8 cm. long, 2.8–4.1 mm. in diameter, cuneate at base, tapering and cuspidate at apex, compressed-triquetrous with nearly flat lateral and narrower, sulcate dorsal faces, the thin, pale green valves becoming papery and stramineous or brownish, cross-reticulate, hirsutulous with ascending or incurved hairs up to 0.55–0.85 mm. long, inflexed as a complete septum 1.7–2 mm. wide; *ovules* 12–14; *seeds* subquadrate, brown sometimes speckled with purple, irregularly wrinkled, 1.9–2.5 mm. long.—Collections: 5 (i); representative: *Eastwood & Howell 8966* (CAS); *Train 1719* (NA).

Outwash fans and gravelly flats in the foothills of calcareous desert mountains, 2050–4500 feet, rare and local, known only from a few scattered localities in Clark (Las Vegas; Moapa; Indian Springs; Lee Canyon) and southern Nye (type-locality) Counties, Nevada.—Map No. 147.—April and May.

ASTRAGALUS NYENSIS (of Nye County, Nevada) Barneby in *Leaff. West. Bot.* 8: 195. 1954, based on *A. Nuttallianus* var. *pilifer* (hairy, of the loose, hirsutulous vesture) Barneby in op. cit. 3: 110, Pl. opp. p. 108. 1942 ("*piliferus*", an incorrect form).—"NEVADA: ... foothills of the Spotted Range, Nye Co. ... Ripley & Barneby 3430."—Holotypus, collected May 14, 1941, CAS! isotypi, RSA, UC (Clokey)!

Three annual milk-vetches with slenderly oblong, trigonous fruits are known to occur under similar conditions in the *Larrea* and Joshua-tree deserts of southern Nevada. The commonest of them, *A. Nuttallianus* var. *imperfectus*, is easily distinguished from the endemic *A. nyensis* by its appressed vesture, prevaillingly elliptic and acute (and never retuse) leaflets, and only minutely strigulose or glabrous, long-persistent pod more abruptly incurved just above the base than distally. The third species, *A. acutirostris*, is seemingly very rare in Nevada; it resembles

Map No. 147. Southeastern California, southern Nevada, and northern Baja California, and inset, lower left, the southern angle of Nevada. Range of  *A. acutirostris*; and of  *A. nyensis*.

A. nyensis in the retuse leaflets, but the acute keel-tip and commonly resupinate pods, carried out on much longer peduncles beyond the fulcrant leaf, provide firm differential characters at all stages of growth.

The Nye milk-vetch, despite its interest for the specialist, can lay no claim to prettiness. When in full flower the tiny, whitish or dimly roseate corollas are almost concealed by foliage, and even the fruits, because of their short common peduncle and mask of spreading-incurved hairs, do not stand out from the leaves to a casual glance. Although certainly a rare plant, *A. nyensis* is easily overlooked and may prove more widely distributed than collections show to date.

The Nye milk-vetch was first collected in May, 1906, at Indian Springs in the east foothills of the Charleston Mountains, by M. E. Jones.

325. ASTRAGALUS ACUTIROSTRIS

Slender, sometimes diminutive, with a subfiliform taproot and 1 (2) erect, or several decumbent and ascending or prostrate and radiating stems, loosely strigulose or pilosulous with subappressed or loosely incurved-ascending hairs up to (0.35) 0.4–0.6 mm. long, the herbage greenish-cinereous, the leaflets somewhat bicolored, brighter green and medially glabrescent above; *stems* 2–25 (30) cm. long, simple or (when vigorous) spurred or branched near the base, commonly tinged with brownish-purple; *stipules* membranous or broadly membranous-margined, deltoid, triangular-ovate, or lanceolate, pallid or early becoming so, 0.8–2.5 (3) mm. long, semialexicaul, glabrous or nearly so dorsally, ciliate with black or white hairs and sometimes a few minute processes; *leaves* (1) 1.5–4.5 cm. long, the lower ones slender-petioled, the upper subsessile, with (7) 9–13 (15) oblong-oblancheolate, obovate, or broadly to narrowly cuneate, almost consistently retuse, flat or loosely folded leaflets 2–8 mm. long; *peduncles* slender, erect, or spreading and incurved, (1.5) 2.5–7 cm. long, all or at least those of the main stems surpassing the leaf; *racemes* loosely (1) 3–6-flowered, the flowers at first ascending, early spreading or declined, the axis early elongating, (0) 1–3.5 (4.5) cm. long in fruit; *bracts* membranous, pallid, ovate-triangular or lanceolate, 0.7–1.3 mm. long; *pedicels* at anthesis straight, ascending, 0.4–0.7 (0.9) mm. long, in fruit somewhat thickened, decurved, contorted, or coiled, 0.9–1.7 mm. long, persistent; *bracteoles* 0; *calyx* (2.6) 2.8–3.5 (4.1) mm. long, loosely strigulose with black, black and white, or exceptionally all white hairs, the subsymmetric disc 0.4–0.7 mm. deep, the membranous, pallid or purplish tube 1.6–2.1 mm. long, 1.4–1.9 mm. in diameter, the subulate teeth mostly (1) 1.2–1.5 mm., more rarely up to 2.3 mm. long, the whole becoming papery, marcescent unruptured; *petals* whitish tinged or margined with lilac, pale or bright purple, the banner striate; *banner* recurved through $\pm 45^\circ$, (4.7) 5–7 mm. long, the short, cuneate claw expanded into an ovate, obovate, or suborbicular, notched or emarginate blade 3.5–5.3 mm. wide; *wings* 4.3–6.2 mm. long, the claws (1.2) 1.5–2 mm., the oblancheolate, obtuse, gently incurved blades 3.3–4.6 mm. long, 1.1–1.6 mm. wide; *keel* (0.4 mm. longer to 0.4 mm. shorter than the wings) 4.3–5.8 mm. long, the claws (1.4) 1.6–2.2 mm., the lunately half-elliptic blades (3) 3.2–3.8 mm. long, 1.3–1.7 mm. wide, incurved through 45–65 (80)° to the narrowly triangular, acute or subacute, often slightly porrect apex; *anthers* (0.2) 0.25–0.4 mm. long; *pod* pendulous, spreading, or ascending and resupinate from the variably decurved or contorted pedicel, disjoining from an obscure gynophore 0.4–0.8 mm. long, the body lunately linear-ellipsoid, very gently and evenly incurved, 1.2–3 cm. long, (2.2) 2.5–3.1 mm. in diameter, cuneate at base, more abruptly contracted distally into a short terminal cusp, laterally compressed-triquetrous, with shallowly concave lateral faces broader than the deeply and narrowly sulcate dorsal face, the thin, green or purple-tinged, sparsely strigulose or exceptionally glabrous valves becoming brownish-stramineous, somewhat lustrous, delicately

cross-reticulate, inflexed as a complete septum 1–1.9 mm. wide; *ovules* 12–26; *seeds* olivaceous, pale or dark brown, sometimes purple-speckled, prominently wrinkled and pitted, dull, 1.5–2.3 (2.5) mm. long.—Collections: 35 (v); representative: *C. B. Wolf* 6595 (CAS, WS), 6652 (ARIZ, CAS, NY, WS); *Ripley & Barneby* 3452 (NY, RSA), 5868 (CAS, NY, RSA); *Munz & Johnston* 5230 (CAS, POM); *J. T. Howell* 33,240 (CAS); *Raven, Mathias & Turner* 12,515, 12,542 (CAS).

Sandy and gravelly flats, desert hillsides, and outwash fans, on granitic and sometimes volcanic rock-formations, apparently of bicentric distribution, widespread in the zones of *Larrea* and Joshua-tree, about 2000–5200 feet, over most of the Mohave Desert, from lower Owens Valley and Death Valley south to the foothills of the San Bernardino and New York Mountains, east to the Belted Range in southern Nye County, Nevada, and south, becoming rarer, along the west edge of the Colorado Desert to the Mexican border; apparently disjunctly, at 100–1800 feet, on the west coast and interior deserts of Baja California, in lat. 30°–30° 30' N.—Map No. 147.—Late March to May.

ASTRAGALUS ACUTIROSTRIS (with sharp keel-tip) Wats. in Proc. Amer. Acad. 20: 360. 1885 (21 Feb.).—"Near Brown's Ranch, Mohave Desert, by Parish Brothers, May, 1882, and on dry rocks above the Calico Mines, near Fort Mohave, by J. G. Lemmon, May, 1884."—Holotypus (*S. B. & W. F. Parish* 1276), GH! paratypus (*Lemmon* 3115), GH! isotypus, DS!—*Oxytropis acutirostris* (Wats.) Jones in Proc. Calif. Acad. Sci. II, 5: 677. 1895. *Spiesia acutirostris* (Wats.) Jones, l.c., nom. provis. *Aragallus acutirostris* (Wats.) A. Hell., Cat. N. Amer. Pl. 4. 1898. *Hamosa acutirostris* (Wats.) Rydb. in Bull. Torr. Club 54: 331. 1927. *Astragalus Nuttallianus* var. *acutirostris* (Wats.) Jeps., Fl. Calif. 2: 379. 1936.

Astragalus streptopus (with twisted pedicels) Greene in Bull. Calif. Acad. Sci. 1: 155. 1885 (7 May).—"Mohave Desert, 1884, collected by Mrs. M. K. Curran."—Holotypus, CAS! isotypus, GH!

The near relationship of *A. acutirostris*, despite its desert habitat, seems to lie in the direction of the cismontane annuals, among which *A. pauperculus* is technically very similar in its loose raceme and often resupinate pod. The species is superficially similar to and over almost its whole range of dispersal is associated with some variety of *A. Nuttallianus*; the two often grow together, are easily confused, and have often been distributed under the same label. Since they are treated in these pages as members of separate subsections, it seems proper and may well be helpful to present the differential characters in key form:

1. Pods readily deciduous from an obscure gynophore, dehiscent at both ends on the ground, disposed (when more than 1) on an axis 1–3.5 (4.5) cm. long, variably oriented by means of simple outward curvature or by more elaborate contortion of the pedicels, the body very gently and evenly incurved, shallowly crescentic; *leaflets* of all leaves retuse or truncate-emarginate _____ *A. acutirostris*
1. Pods sessile but persistent on the receptacle on a shortened axis (this rarely elongating and up to 2 cm. long), spreading or incurved-ascending from simply arched pedicels, the body nearly always incurved just above the base and therefore straight or nearly so (rarely evenly and shallowly crescentic); *leaflets* either all elliptic (then acute or obtuse but not emarginate) or dimorphic, obovate-obcordate in the lower leaves, elliptic in the upper; vars. *imperfectus* and *cedrosensis* of _____ *A. Nuttallianus*

The importance attached in the past to the acute keel-tip of *A. acutirostris* was greatly exaggerated and the transference of the species to *Oxytropis* most unnatural. The keel is no more pronouncedly narrowed upward and no sharper at apex than that of many homaloboid species, and there is no suggestion of the precisely terminal beaklike appendage characteristic of the sister genus (of which all species are moreover sound perennials with quite differently formed pods).

The sharp-keeled milk-vetch in California varies little. The populations discovered quite recently (1958) by Raven and associates in northern Baja California appear to differ in some minor respects. The calyx-teeth are longer (1.5–2.3 mm. as opposed to 1–1.5 mm.) and the pod is also slightly longer and encloses 9–13 rather than 6–8 pairs of ovules and seeds. So far as we know at present the Mexican form is geographically disjunct, the known stations lying at points 150 miles or more distant from the previously established southern limit of *A. acuti-*

rostris at the west edge of the Colorado Desert; very likely it represents a distinct entity. One individual plant from Baja California (*Raven & al.* 12,372, CAS, *pro parte*) is further peculiar in having elliptic and obtuse (not retuse) leaflets and a glabrous, inwardly arched pod such as I have not seen elsewhere in the species. This particular specimen was distributed with material of *A. Nuttallianus* var. *cedrosensis*, with which it was associated in nature; it may be a hybrid. The shape of the leaflets is suggestive of such a possibility, and the genes for a glabrous pod are present in many populations of var. *cedrosensis*.

326. *ASTRAGALUS FRANCISQUITENSIS*

Delicate, diffuse, annual or perhaps sometimes biennial, with a slender taproot, sparsely strigulose with straight, appressed hairs up to 0.3–0.5 mm. long, the herbage green or in youth cinereous, the leaflets bicolored, yellowish-green and glabrous above; *stems* rarely simple and erect, usually 3–numerous, weakly ascending or prostrate, (0.2) 0.4–4 (6) dm. long, simple or branched (spurred) from base up to the first peduncle, floriferous upward from near or below the middle; *stipules* (1) 1.5–5 mm. long, the lowest ovate, early becoming papery-scarious, the upper ones longer, lanceolate or linear-acuminate, thinly herbaceous, green or purplish, not more than semiamplexicaul; *leaves* (1.5) 2–8.5 cm. long, slender-petioled, with (7) 13–21 narrowly elliptic-oblong or oblanceolate, or (in some lower leaves) oblong-obovate, obtuse to shallowly retuse, rather distant and sometimes scattered, flat, thin-textured leaflets 2–11 mm. long; *peduncles* ascending, slender or almost filiform, (2) 4–12 cm. long, mostly much longer than the leaf, the earliest ones sometimes shorter; *racemes* loosely (2) 4–10-flowered, the flowers ascending, the axis a little elongating, (0.5) 1–4 cm. long in fruit; *bracts* scarious, often purplish, broadly to narrowly lanceolate, 1–2 mm. long; *pedicels* ascending, straight or nearly so, at anthesis 0.2–0.7 mm., in fruit 0.7–1.2 mm. long; *bracteoles* 2, mostly minute or setaceous, sometimes 0; *calyx* 4.6–5.6 mm. long, strigulose with mixed black and white hairs, the slightly oblique disc 0.6–0.9 mm. deep, the tube 2.6–3.2 mm. long, $\pm$ 2 mm. in diameter, the lance-subulate or broadly lanceolate teeth 1.4–2.5 mm. long, the whole becoming scarious, ruptured, persistent with the pedicel; *petals* pale purple; *banner* recurved through $\pm$ 50°, ovate-cuneate or oblanceolate, deeply notched, 8.2–10 mm. long, 3.4–6 mm. wide; *wings* 8–9.3 mm. long, the claws 3–3.4 mm., the linear-oblong or -oblanceolate, straight or slightly incurved blades 5.2–6 mm. long, 1.3–2 mm. wide, obtuse, truncate-emarginate, or shallowly retuse at apex; *keel* 5.5–6.4 mm. long, the claws 3–3.4 mm., the half-obovate blades 2.8–3.7 mm. long, 1.7–2.2 mm. wide, abruptly incurved through 100–110° to the bluntly or exactly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* erect or narrowly ascending, sessile, linear-oblong, nearly straight, 1–1.5 cm. long, 2.1–2.8 mm. in diameter, obtuse at base, tapering distally into a very short cusp, compressed-triquetrous, with nearly flat lateral and narrowly but deeply grooved dorsal faces, carinate ventrally by the suture, the thin, green, sparsely strigulose valves becoming papery, stramineous, **finely reticulate**, inflexed as a complete septum $\pm$ 1 mm. wide, the beak unilocular; *ovules* 6–12; *seeds* $\pm$ 1.3–1.6 mm. long.—Collections: 9 (o); representative: *Jones* 24,175 (ARIZ, CAS, NY, POM, SMU, TEX); *Gentry* 4287 (GH, K, US), 4376 (DS, MO); *Carter & Ferris* 3358 (DS).

Stony glades in oak-pine forest and open ridges with piñon, oak, and *Arbutus*, 3500–6000 feet, mountains of the South District of Baja California: Sierra Giganta; Cape region (Sierras de la Laguna, El Taste, de San Francisquito, de la Victoria).—Map No. 142.—October to March, following seasonal rains.

ASTRAGALUS FRANCISQUITENSIS (of San Francisquito) Jones in Proc. Calif. Acad. Sci. II, 5: 666. 1895.—“Brandegge, San Francisquito, Lower California, October 18, 1891.”—Holotypus, collected probably in 1890, CAS! isotypus, UC!—*Hamosa francisquitensis* (Jones) Rydb. in N. Amer. Fl. 24: 429. 1929.

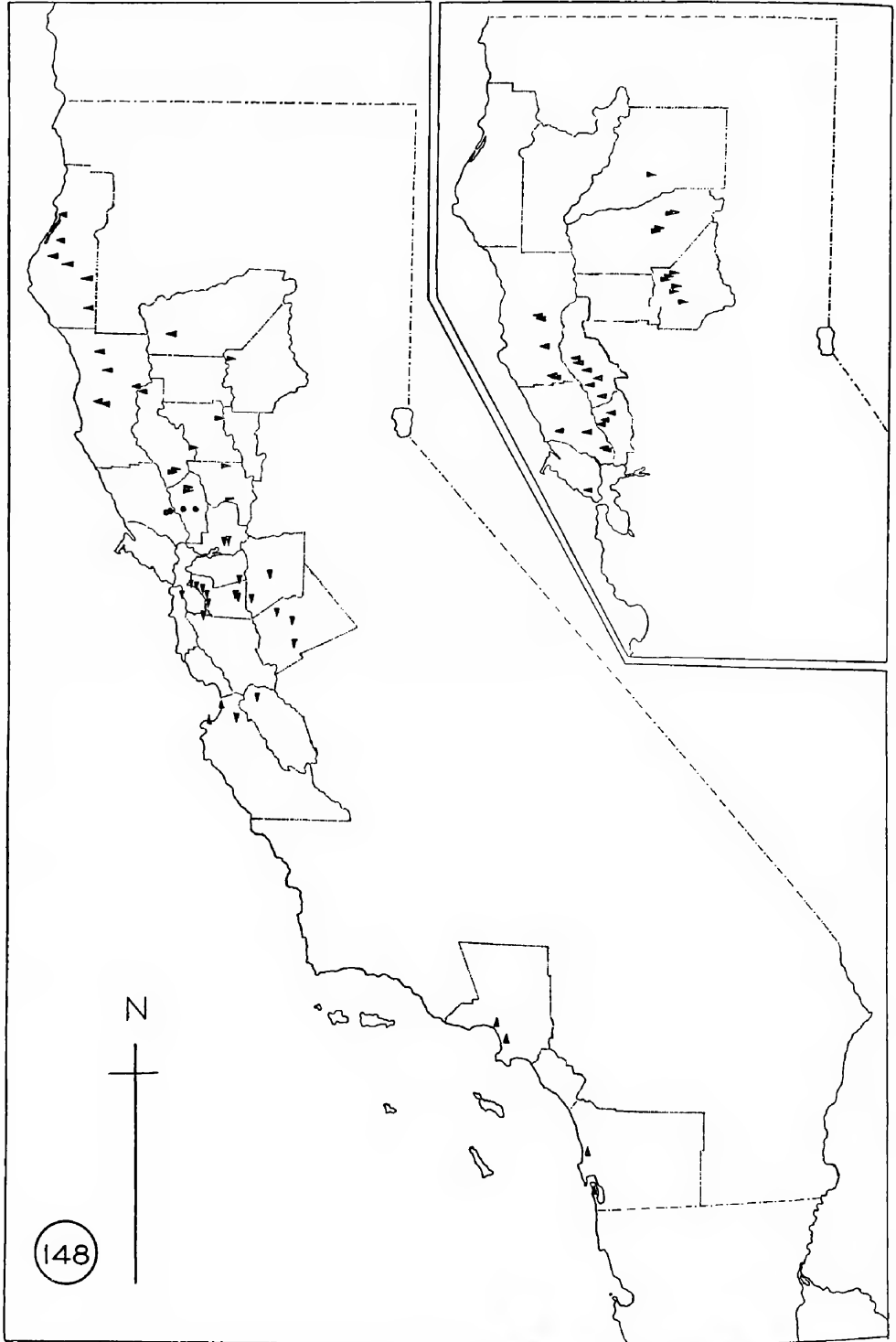
Astragalus lagunensis (of Sierra de la Laguna) Jones, Contrib. West. Bot. 8: 11. 1898 ("Lagunensis").—"Lower California, Brandegee."—Holotypus, collected in Sierra de la Laguna, January 23, 1890, UC! isotypus (fragm. + phototypus), POM!—*A. francisquitensis* var. *lagunensis* (Jones) Jones, op. cit. 10: 61. 1902.

The Laguna milk-vetch, *A. francisquitensis*, is the only astragalus known to occur in the mountains of Baja California below the latitude of Loreto, and is the only species of its type other than the much smaller-flowered, desert-dwelling *A. Nuttallianus* and *A. acutirostris* recorded from the Peninsula. Like annual astragali everywhere it varies greatly in vigor and stature, depending on amount and timing of rainfall; and although the plant may be capable of ripening at least some fruits after only a few weeks growth, it will persist, granted sufficient moisture, until the stems reach a length of 6 dm. and the taproot attains the thickness of a pencil beneath the crown. An occasional individual seems to persist over a dry period and flower a second time, consequently appearing biennial, but the majority of specimens examined are clearly fugitive annuals. The two species described by Jones correspond with extremes of stature, the typus of *A. francisquitensis* being relatively lush, with long stems and long, wide leaflets, while that of *A. lagunensis* is somewhat depauperate, condensed, and smaller-leaved. Specimens collected by Brandegee in Sierra El Taste in 1902 are quite intermediate, and it was probably after examining these that Jones reduced *A. lagunensis* to varietal rank. After his visit to the Laguna Mountains in March, 1928, Jones (Contrib. West. Bot. 15: 134. 1929) came to question the value of the variety, and there seems no doubt that Rydberg (1929, p. 429) appraised the two proposals correctly as exact synonyms.

Jones's identification of *A. francisquitensis* with the perennial white-flowered *A. ervoides* (mentioned further under the latter heading) is patently absurd. In several respects it does resemble one species of continental Mexico, *A. Gentryi*, but is easily distinguished by its very obtuse keel-tip and regularly graduated petals. These two astragali are similar nevertheless in gross aspect and ecology and may be more closely akin than their position in different subsections suggests.

327. ASTRAGALUS TENER

Variable in stature, thinly strigulose with fine, straight, appressed and narrowly ascending hairs up to 0.3–0.6 mm. long, the herbage sometimes subglabrous, deep green, the leaflets always glabrous above, the inflorescence (and often the peduncles and rachis of the upper leaves) black-strigulose or -villosulous; stems solitary and erect, or 3 (the 2 lateral ones ascending from the axils of oblanceolate cotyledons 1–1.5 cm. long), or diffusely branching from 1–several nodes and the lateral branches all diffuse and incurved-ascending, the principal ones (4) 6–30 cm. long; stipules membranous or membranous-margined, pallid, broadly ovate, ovate-acuminate, or the usually narrower and longer upper ones broadly lanceolate, about semiamplexicaul, glabrous dorsally, black- or sometimes white-ciliate; leaves (2) 3–9 cm. long, all petiolate but the upper ones shortly so, with 7–17 flat or loosely folded, rather distant leaflets 3–16 mm. long, varying in outline from broadly obovate-cuneate or obcordate to lanceolate or narrowly oblong and then either retuse, truncate, or obtuse, or linear-elliptic and acute, the leaflets of a given plant either homomorphic (and of either a broad or narrow type), or dimorphic (when of narrow type in the upper leaves); peduncles erect, incurved-ascending, or sometimes divaricate in fruit, 2.5–7 cm. long, either a little longer or shorter than the leaf; racemes subcapitately 3–12-flowered, the flowers loosely spreading, the axis scarcely elongating, 2–8 mm. long in fruit; bracts membranous, ovate or lanceolate, 0.7–2 mm. long; pedicels at anthesis slender, ascending, 0.5–1 mm. long, in fruit a trifle thickened, arched outward, 1–2.3 mm. long; bracteoles 0 (rarely a minute scale); calyx 2.7–5.4 mm. long, densely strigulose-villosulous with black and sometimes a few intermingled white hairs, the disc subsymmetric, the teeth broadly subulate, the ventral pair sometimes broader or longer than the rest, the whole becoming papery, ruptured, marcescent; petals pink-purple, drying violet, the inner margin of the wing-tips pale or white, the banner with a large, pale, striate eye in the fold of the limb, perhaps sometimes subuniformly pale purple or lilac; banner recurved through 35–40°,



Map No. 148. Left, California. Range of *A. tener*:  var. *tener*; and  var. *Titi*; of *A. Rattani*:  var. *Rattani*; and  var. *Jepsonianus*; and of  *A. Clarianus*. Top right, northern California. Range of  *A. pauperculus*; and of  *A. Breweri*.

ovate-cuneate or broadly lance-cuneate, deeply notched, 5.2–11.8 mm. long; *wings* shorter, the blades oblanceolate or obliquely elliptic, obtuse or erose-emarginate, gently incurved; *keel* 3.4–6.4 mm. long, the blades broadly half-obovate or nearly half-circular, incurved through 95–120° to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.2–0.5 mm. long; *pod* ascending, horizontal, or declined, sessile, linear- or narrowly lance-oblong in profile, straight, a trifle decurved, or lunately incurved, (6) 7–16 (20) mm. long, 1.7–3.5 mm. in diameter, rounded at base, shortly acuminate at apex, bluntly and sometimes only obscurely triquetrous, keeled ventrally by the suture, rounded laterally, openly sulcate dorsally, the thinly fleshy, green, glabrous, strigulose, or rarely villosulous valves becoming stiffly papery and brownish, finely reticulate, inflexed as a complete or subcomplete septum 0.6–1.2 mm. wide; *ovules* 5–14; *seeds* (poorly known) apparently brown and smooth, about 1.3–1.5 mm. long.

Key to the Varieties of *A. tener*

1. Flowers relatively large, the banner 8.8–11.8 mm., the keel 4.7–6.4 mm. long; *ovules* (10) 11–14; lower Sacramento and San Joaquin Valleys, San Francisco Bay region (inland from the Ocean), and lower Salinas Valley 327a. var. *tener*
1. Flowers very small, the banner 5–6 mm., the keel 3.4–3.9 mm. long; *ovules* 5–11; coastal from Monterey Bay s. to San Diego 327b. var. *Titi*

327a. ASTRAGALUS TENER var. TENER

Stems 1–several, (4) 6–30 (35) cm. long; *leaves* (2) 3–9 cm. long, with 7–17 leaflets variable in outline as described for the species; *racemes* (3) 5–10 (12)-flowered; *calyx* 3.5–5.4 mm. long, the disc 0.5–0.9 mm. deep, the tube 1.9–3.2 mm. long, 1.7–2.4 mm. in diameter, the teeth 1.3–2.3 mm. long; *banner* 4.4–6.4 mm. wide; *wings* 7.3–9 (9.5) mm. long, the claws 2.1–3.1 mm., the blades 5.7–7 (7.4) mm. long, 2–2.8 mm. wide; *keel-claws* 2.1–3.2 mm. long, the blades 3.3–4.2 mm. long, 1.9–2.2 mm. wide; *pod* 1–1.6 (2) cm. long, 1.8–3.5 mm. in diameter.—Collections: 22 (o); representative: *Eastwood & Howell* 5266 (CAS, GH, NY); *Eastwood* 3818 (CAS, GH, NY, WS); *Hoover* 393 (NY, UC), 4332 (NY); *E. K. Abbott* (from near Salinas) in 1889 (CAS).

Alkaline flats and low meadows moist in spring, below 200 feet, local but forming colonies, central Great Valley and Delta region of California, from Solano to Stanislaus County, west to the east shore of San Francisco Bay (where now largely exterminated) and (formerly) to the east slope of San Francisco Peninsula; apparently isolated in the lower valleys of the San Benito and Salinas Rivers in Monterey and San Benito Counties.—Map No. 148.—March to early June.

ASTRAGALUS TENER (tender and delicate) Gray in Proc. Amer. Acad. 6: 206. 1864.—“California, Douglas: from Monterey or San Francisco.”—Holotypus, GH! isotypi, BM, NY, OXF, P!—*Tragacantha tenera* (Gray) O. Kze., Rev. Gen. 948. 1891. *Hamosa tenera* (Gray) Rydb. in Bull. Torr. Club 54: 323. 1927.

Phaca astragalina β H. & A., Bot. Beechey Voy. 334. 1838.—“... California...,” no collector mentioned, but by inference Douglas.—Holotypus, so labeled, K!

Astragalus Hypoglottis var. *strigosus* (stiffly hairy) Kell. in Proc. Calif. Acad. Sci. 2: 115, fig. 37. 1861.—No locality or collector mentioned.—No spm. preserved at CAS, probably none extant.—*A. strigosus* (Kell.) Sheld. in Minn. Bot. Stud. 1: 24. 1894 (non *A. strigosus* Coult. & Fish., 1893). *Hamosa Kelloggiana* (Albert Kellogg, 1813–1887, a founder of CAS) Rydb. in Bull. Torr. Club 54: 323. 1927.

Astragalus tener var. *rattanoides* (resembling *A. Rattani*) Jones, Rev. Astrag. 268, Pl. 68. 1923 (“*Rattanoides*”).—“Mt. Eden, California, Brandegee, April 27, 1890.”—Holotypus, UC! isotypi, DS, NY, US!—*Hamosa rattanoides* (Jones) Rydb. in Bull. Torr. Club 54: 324. 1927.

The alkali milk-vetch, *A. tener*, is the prototype of the cismontane annual astragali with narrow, dorsally grooved pods. It may be distinguished from its close kindred by the subcapitate arrangement of the relatively short pods, mostly 1–1.5, rarely up to 2 cm. long. Like

most fugitive annuals of dry climates the plants vary greatly in stature from year to year, and from one to the next within a colony. The leaflets of var. *tener* are subject to an unusual type of variation, first noticed by Dr. Kellogg (1861, l.c.) and described in detail by Jepson (1936, p. 378) from observations at Vacaville in Solano County. Within the space of a few square feet the leaflets sometimes vary from linear and acute to oblong-obcordate; they may be alike in all leaves of some plants or pass upward from oblong in the lower to linear and either obtuse or acute in the upper leaves. The pod of the alkali milk-vetch may be straight, gently incurved, or rarely a trifle decurved, and varies in orientation from ascending to declined. This is probably correlated with the attitude of the peduncle, which is apparently sometimes divaricate and possibly humistrate when the fruits are ripe. The valves of the pod may be either glabrous or strigulose, both states being found occasionally together. Thus *Hamosa Kelloggiana*, with lunately incurved, glabrous pod and linear leaflets in the upper leaves, and *H. ratanoides*, which differs in its pubescent pod from the preceding and from the typus of *A. tener* in its narrower leaflets, are clearly no more than arbitrarily selected individual variations belonging to a continuous series.

A plant of adobe flats and low-lying meadows in the central Great Valley and around San Francisco Bay, where man has so vastly altered the pristine ecology and destroyed forever hundreds of square miles of the original plant cover, *A. tener* is a comparatively rare plant, no longer to be found in most of the stations marked on the distribution map. Unless unpublished notes of David Douglas exist, its type-locality cannot be known with certainty. However Howell (in Leaf. West. Bot. 2: 140. 1938) found an especially close match for an isotypus (LE) in the specimen collected near Salinas by Dr. Abbott (CAS, cited supra), and it is possible that Douglas first encountered the alkali milk-vetch in the lower Salinas Valley.

327b. *ASTRAGALUS TENER* var. *TITI*

Dwarf and slender, the 1–3 stems (2) 3–12 cm. long; *vesture* of the herbage sometimes more loosely strigulose than in var. *tener*; *leaves* 2–7 cm. long, with mostly 7–11 (13) obovate-cuneate or oblanceolate, retuse, leaflets; *peduncles* 2–4 cm. long; *racemes* 2–7-flowered; *calyx* 2.7–3.5 mm. long, the disc 0.3–0.6 mm. deep, the tube 1.6–2 mm. long, 1.4–1.7 mm. in diameter, the teeth 0.9–1.5 mm. long; *banner* 2.6–4 mm. wide; *wings* 4.5–5 mm. long, the *claws* 1.4–1.7 mm., the blades 3.3–3.8 mm. long, 1.1–1.6 mm. wide; *keel-claws* 1.5–1.6 mm., the blades 2.1–2.5 mm. long, 1.3–1.5 mm. wide; *pod* (6) 7–14 mm. long, 1.7–2.7 mm. in diameter, straight or slightly decurved, strigulose or rarely villosulous.—Collections: 8 (o); representative: *E. K. Abbott* (from Monterey) *s. num.* (CAS); *Abrams 3251* (CAS, DS, GH, NY, WS); *Jones 3155* (CAS, GH, NY, POM); *Purer 7466* (WIS), 7479 (SD).

Moist, sandy depressions of bluffs or dunes along and near the Pacific Ocean, 50 feet or lower, rare and seldom collected, the known stations scattered: Monterey Bay (Moss Beach; Monterey; Pacific Grove); San Luis Obispo County (s. loc.); coast of Los Angeles plain (Santa Monica; Hyde Park—probably extinct); near San Diego (Soledad; Silver Strand).—Map No. 148.—Late March to May.

ASTRAGALUS TENER var. *TITI* (Eastw.) Barneby in *El Aliso* 2: 209. 1950, based on *A. Titi* (Dr. Frank H. Titus, b. 1851, San Francisco physician) Eastw. in *Bull. Torr. Club* 32: 195. 1905.—“Collected by Dr. F. H. Titus . . . on the Seventeen Mile Drive at Monterey, California, about four miles from Pacific Grove . . .” The type specimens were collected by Mrs. Joseph Clemens, May 8, 1904.—Holotypus, from Moss Beach, Monterey County, CAS! isotypus, UC!

The var. *Titi* differs from typical *A. tener* in its smaller flowers and its ecology. On the shores of Monterey Bay the pod is uniformly small, about 6–9 mm. long, and only 5–6-ovulate, and varies from strigulose to villosulous, sometimes in the same population (*Abbott, CAS*). In the disjunct localities in southern California the pod tends to be longer and up to 11-ovulate. Possibly two minor entities are involved, but I have too little evidence to estimate their importance.

328. *ASTRAGALUS PAUPERCULUS*

Slender, delicate, sometimes diminutive, with one erect or more often 2–5 incurved-ascending stems arising from the cotyledons or first nodes, strigulose

nearly throughout with straight, appressed or narrowly ascending hairs up to 0.3–0.5 mm. long, the herbage green or (when young) cinereous, the leaflets glabrous or thinly pubescent toward the margins above; *stems* 1–8 (11.5) cm. long, simple or bearing a slender spur or branchlet at 1–2 nodes preceding the first peduncle, purple-tinged, commonly floriferous from the middle or below; *stipules* broadly ovate or triangular-acuminate, 1–3 mm. long, submembranous, greenish or purplish becoming papery and brownish, about semiamplexicaul, glabrous or nearly so dorsally, the margins black- or white-ciliate and sometimes beset with a few minute processes; *leaves* 1.5–5 cm. long, with filiform petioles and (5) 7–11 rather remote, oblong-ob lanceolate, obovate-cuneate, or exactly cuneate, truncate or commonly retuse, flat or loosely folded leaflets 2–8 mm. long; *peduncles* subfiliform, ascending or incurved-ascending at anthesis, divaricate or declined in fruit, 2.5–7 cm. long, surpassing the leaf; *racemes* loosely 2–5 (7)-flowered, the flowers at first ascending, usually declined and secund in age, the axis more or less elongating, (0.4) 0.7–2 cm. long in fruit; *bracts* membranous, pallid or purplish, ovate or lanceolate, 0.8–1.5 mm. long; *pedicels* at anthesis slender, ascending, 0.5–1.3 mm. long, in fruit thickened, either straight and ascending, arched outward and downward, or recurved and contorted, 0.8–1.5 mm. long; *bracteoles* 0, rarely a minute scale; *calyx* 2.9–4.3 mm long, strigulose with black and sometimes a few intermingled white hairs, the subsymmetric disc 0.4–0.7 mm. deep, the membranous, purplish tube 2.2–2.8 mm. long, 1.5–2.1 mm. in diameter, the subulate teeth 0.7–1.5 mm. long, the whole becoming papery-membranous, ruptured, marcescent; *petals* pink- or violet-purple, the banner with a pale, striate eye in the fold, the inner margins of the wings pale or white; *banner* recurved through $\pm 40^\circ$, ovate-cuneate, deeply notched, 5.4–10.5 mm. long, 3.7–7.3 mm. wide; *wings* a little shorter, 5.3–10.2 mm. long, the claws 1.8–2.5 mm., the oblanceolate, obtuse, truncate, or emarginate, nearly straight blades 4.1–8.4 mm. long, 1.4–2.9 mm. wide; *keel* much shorter than either wings or banner, 4.3–5.8 mm. long, the claws 1.9–2.7 mm., the half-obovate or nearly half-circular blades 2.7–3.7 mm. long, 1.5–2.3 mm. wide, incurved through $95\text{--}110^\circ$ to the broadly deltoid, sometimes minutely porrect apex; *anthers* 0.3–0.5 mm. long; *pod* deflexed, declined, or ascending and then commonly resupinate, sessile, narrowly crescentic in outline, 1.2–2 cm. long, 2.6–3.4 mm. in diameter, rounded at base, tapering distally into a short, triangular-acuminate, laterally flattened beak, otherwise bluntly triquetrous (becoming somewhat quadrangular when fully ripe), carinate ventrally by the thick suture, the lateral angles obtuse, the lateral faces at first low-concave becoming distended by the seeds, a little wider than the shallowly sulcate dorsal face, the thin, purplish or brightly purple-mottled, sparsely and minutely strigulose or rarely glabrous valves becoming papery, finely cross-reticulate, inflexed as a complete or subcomplete septum 1.4–2.3 mm. wide; *ovules* 8–12; *seeds* subquadrate, brown, sometimes purple-speckled, wrinkled but sublustrous, 2.2–3.2 mm. long.—Collections: 13 (ii); representative: *A. Heller* 11,286 (CAS, G, MO, ND, NY, US); *Hoover* 3236 (NY, WS); *Barneby* 11,491 (CAS, NY, RSA), 11,496 (CAS, RSA); *J. T. Howell* 2304 (CAS).

Stony flats and about shallow depressions or ephemeral rain pools in the foothills and rolling plains, in red sand or clay of volcanic origin, 450–2050 feet, locally plentiful in scattered stations along the west base of the Cascade Range about the upper waters of the Sacramento River in Shasta, Tehama, and Butte Counties, California.—Map No. 148.—March to early May.

ASTRAGALUS PAUPERCULUS (poor and little) Greene in Pittonia 3: 224. 1897.—“... first collected by myself now more than twenty years since, on a dry hillside of the upper Sacramento, but in flower only ... Fruiting specimens sent in recently from the same district indicate

its close relationship to *A. tener* and *A. Rattani*."—No Greene collection and no fruiting typus found at CAS, ND, or UC. Presumed holotypus, identified by Greene as *A. pauperculus*, labeled "Bluffs of Little Chico Creek, May, 1896, Mrs. R. M. Austin," in flower only, ND!

Astragalus tener var. *Bruceae* (Carola Josephine, daughter of Rebecca Merritt Austin, afterward Mrs. Charles Clinton Bruce, 1865–1931, amateur botanist active in n.-e. California and adjoining Oregon, often in the company of her mother) Jones, Rev. Astrag. 268, Pl. 68, 1923 ("*Brucae*").—"No. 2430 Mrs. Bruce, plains of Butte Co., blooming in March."—Holotypus, collected in 1898, POM! isotypus, NY!—*Hamosa Bruceae* (Jones) Rydb. in N. Amer. Fl. 24: 426. 1929. *Astragalus Bruceae* (Jones) Abrams, Ill. Fl. Pac. St. 2: 603, fig. 2893. 1944.

The Bruce milk-vetch, *A. pauperculus*, is a delicate and delightful little astragalus, closely related to *A. tener* and *A. Rattani* as Greene pointed out, but easily distinguished from both by its loose fruiting raceme (over 1 cm. long when, as most often, over 2-flowered), and from *A. Rattani* var. *Jepsonianus* in particular by its comparatively short pod rounded rather than acuminate tapering at base. In the related species the pod is either green or suffused with purple on the side exposed to maximum sunlight, while that of the Bruce milk-vetch is nearly always brightly mottled with purplish-red, the mottlings sometimes running together into a deep purple field. Because of the great variation in the curvature of the fruiting pedicels, the ripe pod is variably oriented, perhaps most often declined or deflexed, but almost as often ascending and resupinate as in the desert-dwelling *A. acutirostris*. Quite variable in stature, some plants of *A. pauperculus* flower from very early nodes close to the ground, and even the most vigorous individuals rarely exceed a decimeter in height.

So far as my information goes, *A. pauperculus* is the only representative of its group on the west slope of the Sacramento Valley in Shasta and Tehama Counties, where it is apparently confined to volcanic soils. In Butte County it has been found at low elevations on the valley floor, where it overlaps the range of *A. Rattani* var. *Jepsonianus* (poorly illustrated by the map, due to lack of precise data). Field studies should be undertaken in this area to determine whether and in what way the species are ecologically separated. Although sometimes occupying the bed of shallow vernal pools in the foothills, the Bruce milk-vetch is by no means characteristic, as is *A. tener*, of soils waterlogged in early spring. It seems most vigorous and most at home on well-drained slopes, rooting in a porous medium of red, cindery gravels mixed with a little humus.

329. ASTRAGALUS RATTANI

Variable in stature but usually quite slender, thinly strigulose with fine, straight, appressed or narrowly ascending hairs (distally often partly black or fuscous) up to 0.2–0.45 mm. long, the herbage green, the leaflets glabrous above; *stems* solitary and erect or 2–3 from the lowest nodes, the lateral ones sometimes again forking, either incurved-ascending or decumbent with ascending tips, the main axes (2.5) 4–30 cm. long, floriferous upward from near or well below the middle; *stipules* (1) 1.2–4 mm. long, submembranous, pallid, greenish, or purplish, becoming papery in age, triangular, ovate- or deltoid-acuminate, glabrous or nearly so dorsally, black- or white-ciliate, the blades commonly squarrose; *leaves* (1.5) 2–5 cm. long, slender-petioled but the uppermost ones shortly so, with (5) 7–11 (13) broadly obovate or obovate-cuneate, more rarely (especially in some upper, but sometimes in all leaves) oblanceolate or (in some early leaves) suborbicular-obcordate, emarginate or retuse, flat or loosely folded leaflets 2–12 mm. long; *peduncles* erect, (1.5) 2–7 cm. long, mostly as long or longer than the leaf; *racemes* very shortly or subumbellately 2–10-flowered, the flowers spreading, the axis not elongating, 1–4 (5) mm. long in fruit; *bracts* membranous, ovate or triangular-acuminate, 0.5–0.8 mm. long; *pedicels* ascending, straight, at anthesis 0.3–0.7 mm., in fruit thickened and 0.5–1.3 mm. long; *bracteoles* 0.2, minute when present; *calyx* 2.5–5 mm. long, rather densely strigulose with black or commonly mixed black and white hairs, the subulate teeth about $\frac{1}{3}$ – $\frac{1}{2}$ as long as the campanulate tube, the whole becoming papery, marcescent unruptured; *petals* pink-purple with paler wing-tips and pale, striate eye in the banner-blade, or sometimes only the distal third of the banner and the keel-tip purple, exceptionally white throughout; *banner* recurved through $\pm 40^\circ$, broadly elliptic-oblanceolate or ovate-cuneate, subtruncate or notched at apex, 7.2–12 mm. long; *wings* shorter, the blades

oblong-oblongate, obliquely truncate or subemarginate, straight or a trifle incurved distally; *keel* 3.8–8.1 mm. long, the half-obovate blades incurved through 90–100° to the broadly rounded or deltoid, often obscurely porrect apex; *anthers* 0.3–0.55 mm. long; *pod* ascending at a narrow or a wide angle, sessile on the slightly elevated receptacle, very narrowly linear-acuminate in profile, (1.5) 1.8–5 (5.7) cm. long, 1.7–2.7 (3.1) mm. in diameter, either gently incurved or straight, cuneate or cuneately tapering (and then sometimes pseudostipitate) at base, gradually tapering upward into a stout, straight, subulate beak 3–7 mm. long, obscurely trigonous when young, subterete in age, low-carinate by the scarcely elevated ventral suture, shallowly sulcate dorsally (the groove sometimes closed), the thinly fleshy, green or purple-tinged, finely strigulose valves becoming papery, brownish-stramineous, delicately reticulate, inflexed as a complete or semicomplete septum 0.6–1.6 mm. wide; *ovules* 8–20; *seeds* narrowly oblong, brown, sometimes purple-dotted, pitted or wrinkled or both, scarcely lustrous, 2.1–3.2 mm. long.

The Rattan milk-vetch, variable in flower-size and pod-length, has broken up into two races, a more vigorous var. *Rattani* of the outer North Coast Range and a more slender one of the inner Coast Range and foothills bordering the lower Sacramento Valley. In either phase *A. Rattani* is distinguished from *A. tener* by its longer, often needle-like pod cuneately tapering rather than rounded at base, and by the same characters and the subumbellate fruiting raceme from *A. pauperculus*.

Key to the Varieties of *A. Rattani*

1. Calyx 3.7–5 mm. long; *banner* (9.2) 10–12 mm. long; *keel* 6.3–8.1 mm. long; *pod* (2.1) 2.5–5 (5.7) cm. long; *ovules* (11) 14–20; outer Coast Range in Humboldt, Mendocino, and n.-w. Lake Counties, rarely e. to the inner Coast Range in w. Tehama County 329a. var. *Rattani*
1. Calyx 2.5–3.4 mm. long; *banner* 7.2–9.6 mm. long; *keel* 3.8–5.1 mm. long; *pod* (1.5) 1.8–3 cm. long; *ovules* 8–12; inner Coast Range and foothills of lower Sacramento Valley 329b. var. *Jepsonianus*

329a. *ASTRAGALUS RATTANI* var. *RATTANI*

Hairs of the herbage mostly up to 0.3–0.45 mm. long; *leaflets* (5) 7–11 (13); *racemes* 2–10-flowered; *calyx-tube* 2.7–3.4 mm. long, 1.8–2.6 mm. in diameter, the disc 0.7–1 mm. deep, the teeth 0.9–1.7 mm. long; *petals* pink-purple with paler claws and wings-tips, rarely white; *banner* 4.9–6.4 mm. wide; *wings* (7.7) 8–10.4 mm. long, the claws (2.5) 2.7–3.7 mm., the blades 5.9–7.6 mm. long, 1.9–3 mm. wide; *keel-claws* 2.4–3.6 mm., the blades 4.5–5.5 mm. long, 2–2.4 mm. wide.—Collections: 20 (i); representative: *Peirson* 7058 (NY, RSA); *M. S. Baker* 9535 (CAS); *Eastwood* 12,944, 12,944a (CAS); *Barneby* 11,573 (CAS, NY, RSA); *Jepson* 13,756 (UC-JEPS).

Open grassy hillsides, gravelly flats in the valleys, and gravel bars of stream and river beds, 100–2000 (2500) feet, uncommon but forming colonies in the outer North Coast Range of California, especially in the valleys of the Mad, Van Duzen, and Eel Rivers, central Humboldt to central Mendocino and extreme north-western Lake Counties, east to the east slope of the Yollo Bolly Range in western Tehama County.—Map No. 148.—Mid-April to July.

ASTRAGALUS RATTANI (Volney Rattan, 1840–1915) Gray in Proc. Amer. Acad. 19: 75. 1883.—“Mendocino Co., California, on prairies north of Mad River, and on Rattlesnake Creek, June, 1882, *V. Rattan*.”—Holotypus, GH! isotypi (*ex herb. Gray.*), K, ND, P!—*Hamosa Rattani* (Gray) Rydb. in Bull. Torr. Club 54: 324. 1927.

The typical form of the Rattan milk-vetch is notable for the great length and slender outline of the fruits. They are commonly almost straight and ascend, two or three together, from the tips of the peduncles in a manner reminiscent of *Amsonia* follicles or the long-beaked mericarps of the umbellifer *Scandix*. In their length they seem to represent an evolutionary peak among the cismontane annuals and are probably more highly modified than the pods of

var. *Jepsonianus*, which is both geographically and morphologically more nearly central to its group. The flowers of var. *Rattani* are pink-purple throughout, but the color varies in vividness, and albino individuals are known to occur. A specimen from Dos Rios, Mendocino County (E. W. Wright in 1927, CAS) was identified by the collector as a locoweed, but the species should not be condemned without experimental proof.

329b. *ASTRAGALUS RATTANI* var. *JEPSONIANUS*

A little more thinly pubescent than var. *Rattani*, the hairs a trifle shorter, up to 0.2–0.4 mm. long; leaflets mostly 7 or 9, cuneate-oblongate; racemes 4–9-flowered; calyx-tube 1.8–2.4 mm. long, 1.3–1.8 mm. in diameter, the disc 0.5–0.7 mm. deep, the teeth 0.6–1.2 mm. long; petals commonly bicolored, only the distal third of the banner and the keel-tip purple-maculate, but sometimes all suffused with pink-purple, exceptionally all white; banner 3.5–5 (5.4) mm. wide; wings 5.8–8 mm. long, the claws 1.7–2.3 mm., the blades 4.7–6.5 mm. long, 1.5–2.4 mm. wide; keel-claws 1.4–2.3 mm., the blades 2.5–3.5 mm. long, 1.5–1.8 mm. wide.—Collections: 16 (o); representative: *Eastwood & Howell 5634* (CAS); *Ferris 706, 6281* (DS, NY); *M. S. Baker 8938, 12,940* (CAS); *Mrs. Bruce 2078, 2432* (DS, NY).

Meadows, grassy hillsides and valley floors, and openings in chaparral, commonly on or near serpentine outcrops, about 1100–1900 feet, local but forming colonies, inner North Coast Range of California, southern Lake and northern Napa to western Colusa and western Tehama Counties, northeast (in unknown habitats) to the floor of the Sacramento Valley in Yolo and Butte Counties.—Map No. 148.—April to early June.

ASTRAGALUS RATTANI var. *JEPSONIANUS* (Willis Linn Jepson, 1867–1946, most distinguished botanist of his generation in California) Barneby in *Aliso* 4: 137. 1958.—“CALIFORNIA. Walter Springs, Napa County, April 30, 1939, *J. T. Howell No. 14,625* . . .”—Holotypus, CAS! isotypus, DS!

The existence of a short-fruited form of the Rattan milk-vetch, apparently replacing the typical form of its species in the inner North Coast Range, was first mentioned by Jepson (1936, p. 379), who cited collections from western Colusa and Tehama Counties as examples. Plants characterized by a fruit about 1.5–3 cm. long occupy a natural area extending from the serpentine country in southern Lake and adjoining Napa County north and east to the floor of the Sacramento Valley in Butte and Yolo Counties; and the short pod coincides with relatively few ovules and slightly but consistently smaller flowers. In Butte County (from which there are three collections, but only one sufficiently documented to permit mapping) the variety overlaps the range of *A. pauperculus*, which is easily distinguished by its elongating raceme-axis and mottled, commonly resupinate, shorter and slightly broader (thus proportionately a good deal broader) pod. In Lake and Napa Counties var. *Jepsonianus* is sympatric with *A. Breweri* and closely approaches *A. Clarianus*, the differential characters of which are stressed elsewhere.

Like all the cismontane annuals, *A. Rattani* var. *Jepsonianus* is a pretty little plant, with three or four pairs of small, neatly cuneate-oblongate leaflets to the average leaf, subumbellate inflorescence of about seven flowers, and an extremely slender, usually incurved pod dorsally grooved when young but often subterete when distended by the crowded, quadrately oblong seeds. The flowers vary considerably in color, being sometimes uniformly pink-purple as in var. *Rattani*, perhaps more often bicolored with the pigment concentrated in the form of a broad margin or transverse band across the distal third of the banner and the keel-tip, the remainder being white or faintly roseate.

Although described only latterly in its present status, the substance of var. *Jepsonianus* has been recognized as a species distinct from *A. Rattani* under the name *A.* (or *Hamosa*) *Clarianus* by Abrams and by Rydberg, a point mentioned further under the next. The finely executed figure of “*A. Clarianus*” in Abrams (1944, fig. 2895) portrays var. *Jepsonianus* to the life.

330. *ASTRAGALUS CLARIANUS*

Very slender, ephemeral, sparsely leafy annual, with a filiform taproot, thinly strigulose with appressed hairs up to 0.25–0.4 mm. long, the herbage green, the leaflets glabrous above, the inflorescence fuscous- or black-strigulose; stems solitary and erect or more commonly 2–3, the lateral ones ascending from the axils of

the cotyledons (these oblanceolate, obtuse, 9–11 mm. long) or from the first node, simple or (in some vigorous plants) branched near the base, (2) 3–10 (23) cm. long, floriferous from 2–4 (6) distal nodes; *stipules* submembranous, pale green or purplish becoming papery and pallid or brownish in age, broadly ovate or ovate-acuminate, 1–2.5 (3) mm. long, about semialexicaul, glabrous dorsally, all but the lowest sparsely black- or fuscous-ciliate; *leaves* 1.5–5 cm. long, with slender petioles and 5–9 cuneate-obovate to narrowly cuneate, deeply retuse, flat, rather distant leaflets 2–10 mm. long; *peduncles* at first ascending, declined or divaricate in age, 2–7 cm. long, surpassing the leaf; *racemes* subcapitately 2–7-flowered, the flowers becoming horizontal and at last declined, the axis scarcely elongating, 2–10 (13) mm. long in fruit; *bracts* submembranous, ovate, 0.7–1.2 mm. long; *pedicels* at anthesis ascending or a little arched outward, 0.4–1 mm. long, in fruit straight and widely ascending or arched outward, a little thickened, 0.8–2.2 mm. long; *bracteoles* 0; *calyx* 2.8–4 mm. long, densely strigulose with black or dark brown hairs, the subsymmetric disc 0.5–0.8 mm. deep, the tube 2.1–2.6 mm. long, 1.6–2.3 mm. in diameter, the broadly subulate or triangular, obtuse teeth 0.6–1.4 mm. long, the whole becoming papery, marcescent unruptured; *petals* bicolored, whitish but the distal third of the banner and the keel-tip maculate with dark lilac, drying violet; *banner* recurved through only 20°, 8.9–12 mm. long, the short, cuneate claw expanded into a broadly oblong-elliptic or ovate-oblong, openly and shallowly emarginate blade 4.8–6 mm. wide; *wings* 6.7–9 mm. long, the claws 1.6–2.3 mm., the linear-oblong, oblong, or oblong-elliptic, obtuse or obliquely truncate blades 5.5–7.5 mm. long, 1.5–2.4 mm. wide; *keel* as long or commonly a little (0.2–1.5 mm.) longer than the wings, 7.4–9.1 mm. long, the claws 2.1–2.7 mm., the obliquely triangular blades 5.7–7.2 mm. long, 2.8–3.5 mm. wide, abruptly incurved through (85) 90° to the broad, rounded apex; *anthers* 0.4–0.5 mm. long; *pod* horizontal or declined, sessile but elevated on and disjointing from a slender gynophore 1.4–2.5 mm. long, also pseudostipitate, the narrowly crescentic body 1.7–2.5 cm. long, (1.6) 2–3.1 mm. in diameter at or near the middle, long-attenuate at both ends, at base into a straight, slender, sterile, stipelike portion, distally into a long-subulate, strongly incurved or hooked beak, at the middle obscurely triquetrous, obtusely carinate ventrally by the suture, rounded dorsally, the thinly fleshy, green or faintly brown-mottled valves becoming stiffly papery and brownish, finely strigulose with white and often a few black hairs, inflexed as a complete or nearly complete septum; *ovules* 6–12; *seeds* brown, sparsely pitted, dull, 2.7–3.3 mm. long.—Collections: 7 (ii); representative: *J. T. Howell* 6431 (CAS, MO, POM), 6442 (CAS, GH, K, US); *Mrs. Hunt* (from near St. Helena) in 1922 (CAS); *Barneby* 11,238 (CAS, NY, POM, RSA); *Jepson* 13,756 (UC-JEPS).

Open grassy hillsides, especially on exposed shoulders in thin volcanic clay soil moist in spring, 300–550 feet, rare and local, known only from the inner North Coast Range about St. Helena and Santa Rosa, in Napa and Sonoma Counties, California.—Map No. 148.—April to May.

ASTRAGALUS CLARIANUS (Clara A., Mrs. D. O. Hunt, the collector, a correspondent of Jepson) Jeps., Man. Calif. 578, fig. 570. 1925 ("*clarianus*").—"Napa Range: near St. Helena (Clara A. Hunt, type)."—Holotypus, "received April 8, 1909," UC-JEPS!—*A. Rattani* var. *Clarianus* (Jeps.) Jeps., Fl. Calif. 2: 379. 1936 ("*clarianus*"). *Hamosa Clariana* (Jeps.) Rydb. in N. Amer. Fl. 24:427 (quoad nom.). 1929.

The Napa milk-vetch, *A. Clarianus*, in most features nearly resembles and is probably derived by mutation from *A. Rattani* var. *Jepsonianus* or an immediate common precursor; of the two it is clearly the more highly modified organism. The petals of both species are (in var. *Jepsonianus* inconsistently) bicolored, remarkable for the vivid anthocyanic band or border painted across the distal third of the banner and the keel-tip, in contrast to the

whitish or palest pink wings and claws. In both the extremely narrow, elongate pod is attenuate at either end, at apex into a long-subulate, cusplike beak, and at base into a sterile, stipelike neck. But the Napa milk-vetch differs greatly in the relative proportions of the petals and is instantly recognized by the prominent broad keel which equals or ordinarily shortly surpasses the narrow wings. The flower resembles, to a surprising degree, that of the wholly unrelated *A. alpinus*. Furthermore the pod, although technically sessile as in *A. Rattani*, is elevated out of the bed of the calyx on a slender, stipelike gynophore and, with its attenuate sterile base, is doubly pseudostipitate, a combination unique in the genus so far as my knowledge goes.

The Napa milk-vetch is among the rarest of California's many endemic astragali, known probably from only three localities, although one of them extends interruptedly over an area of two or three square miles. It is recorded only from near St. Helena; from Conn Valley, Napa County, now the site of the reservoir Lake Hennessey; and from points about seven or eight miles northeast of Santa Rosa on the old Spring Valley road to St. Helena where it was still locally plentiful until a few years ago. The whole known range of var. *Clarianus* does not exceed fifteen miles in diameter. The more extensive dispersal attributed to the species by Rydberg (1929, p. 427) and Abrams (1944, p. 603, fig. 2895) was based on confusion with *A. Rattani* var. *Jepsonianus*.

331. ASTRAGALUS BREWERI

Slender but variable in stature, rather sparsely leafy, with 1–3 or sometimes several erect or diffusely ascending stems from a subfiliform taproot, thinly strigulose with straight, appressed or narrowly ascending, white and (toward the inflorescence) black or fuscous hairs up to 0.3–0.55 mm. long, the herbage green or sometimes cinereous in youth, the leaflets glabrous above; *stems* (1.5) 4–30 cm. long, simple, commonly purplish at base, stramineous in age; *stipules* (1) 1.5–4.5 mm. long, ovate or ovate-acuminate, rarely lanceolate, membranous becoming papery and brownish, semi- or almost fully amplexicaul, glabrous or nearly so dorsally, the margins ciliate and often beset with a few minute processes; *leaves* (1.5) 2–6 (7.5) cm. long, shortly petioled, with 7–13 rather distant, narrowly oblong-oblancheolate to broadly obovate-cuneate, retuse or (in some leaves of a plant or throughout some plants) oblong-elliptic and obtuse, flat leaflets 3–10 (12) mm. long; *peduncles* erect or divaricately ascending, (2) 3–9 (11) cm. long, surpassing the leaf; *racemes* subcapitately 3–10-flowered, the flowers ascending and spreading, the axis not or scarcely elongating, less than 5 mm. long in fruit; *bracts* membranous, pallid, ovate or lanceolate, 0.6–2 mm. long; *pedicels* ascending, straight or a little arched outward, at anthesis 0.4–0.8 (1.1) mm., in fruit a trifle thickened and 0.7–1.4 mm. long; *bracteoles* 0 (rarely a rudimentary scale); *calyx* 3.8–5.1 mm. long, densely strigulose-pilosulous with black or fuscous often mixed with some (rarely all) white hairs, the subsymmetric disc 0.4–1 mm. deep, the campanulate tube 2.5–3.5 mm. long, 1.8–2.5 mm. in diameter, the subulate teeth 1–2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish with maculate keel, or the banner, and sometimes also the wings, veined and suffused with lilac; *banner* recurved through 35–45°, rhombic-obovate or -elliptic, or broadly rhombic, usually deeply notched, 7.8–11.4 mm. long, (3.5) 4.2–6 mm. wide; *wings* 6.7–9.2 mm. long, the claws 2.3–3.7 mm., the oblong-oblancheolate, obliquely truncate-undulate or shallowly emarginate, nearly straight or gently incurved blades 4.8–7 mm. long, 1.8–2.8 mm. wide; *keel* (5) 5.4–7.8 mm. long, the claws (2) 2.3–3.6 mm., the half-obovate blades 3.3–4.9 (5.1) mm. long, 1.7–2.3 mm. wide, incurved through 90–95° to the rounded apex; *anthers* 0.35–0.5 mm. long; *Pods* stellately ascending in subumbellate heads, sessile on the low-convex receptacle, composed of an ovoid, ovoid-oblong, or fusiform, densely (sometimes rather loosely) silvery-strigulose body 5.5–10 mm. long, (2.5) 2.8–4 mm. in diameter, acuminate tapering or cuneately contracted upward into a straight, erect or slightly declined, elongately subulate, spinelike (but not vulnerant), glabrescent beak (3.5) 4–10 mm. long, the body ob-

tusely triquetrous with rounded-convex ventro-lateral faces and deeply sulcate dorsal face, the thinly fleshy, green valves becoming stiffly papery, smooth or nearly so beneath the vesture, inflexed as a complete septum (0.9) 1.2–2.1 mm. wide, the septum produced upward at least into the base of the beak; *dehiscence* tardy, the pod falling entire but finally splitting through both sutures and the septum into two false carpels; *ovules* commonly 4, rarely 2, 3, or 6; *seeds* mahogany- or sooty-brown, elaborately pitted and wrinkled, 2.5–3.4 mm. long.—Collections: 30 (iii); representative: *Eastwood 3164*, 11,355 (CAS); *Abrams 14,331* (NY, WS); *J. T. Howell 1303* (CAS, NY), 18,018 (CAS, RSA, TEX), 29,146 (CAS, NY); *Hoover 4038*, 4920 (NY); *Barneby 11,577* (CAS, NY, RSA).

Grassy flats, meadows moist in spring, and open slopes in the chaparral belt below 2000 feet, commonly on or near volcanic or serpentine outcrops, locally plentiful in propitious seasons in the interior valleys and foothills of the Coast Ranges in southeastern Mendocino, Lake, Napa, and Sonoma Counties, southwest to the Pacific slope of Mt. Tamalpais, Marin County, California.—Map No. 148.—Late March to June.

ASTRAGALUS BREWERI (William Henry Brewer, 1828–1910, principal botanist of the California Geological Survey, 1860–1864, author with Sereno Watson of the first state flora) Gray in Proc. Amer. Acad. 6: 207. 1864.—“California, ‘in the Sonoma valley, common in fields: April 18.’ Dr. W. H. Brewer.”—Holotypus (*Brewer 979*), GH! isotypi, K, NY, UC, US! —*Tragacantha Breweri* (Gray) O. Kze., Rev. 943. 1891.

Over a small part of its range in Lake and Mendocino Counties *A. Breweri* is sympatric with forms of *A. Rattani*. The two species, found in similar environments, are much alike in habit of growth and floral morphology. Flowering specimens of the Brewer milk-vetch may be distinguished by the few ovules, usually four or very rarely up to six as opposed to eight or more in *A. Rattani*; but the extremely distinct fruits form early in the season and provide the simplest means of identification. The remarkable fruits of the Brewer milk-vetch, which are disposed at the tip of the peduncles in a seemingly umbellate, stellately spreading or ascending cluster, are divided abruptly into two parts, an ovoid or oblong-ellipsoid body densely beset with silvery hairs, and an erect or slightly declined, long-subulate, almost spinelike beak of nearly equal length but much less densely pubescent. Comparison of the beak with that of *A. Rattani* shows the two to be of the same structure. And it is not difficult to imagine a mutation involving an abrupt shortening (or telescoping) of the pod-body in a precursor of both species, and consequently the elimination of the sterile base, which might produce a fruit of the *A. Breweri* type. A shortening of the fruit without loss of hairs might even produce the very striking inequality in density of pubescence between the body and the presumably unaltered beak. Such hypothesis is at least more plausible than that adumbrated by Rydberg when he created for *A. Breweri* a monotypic section in *Astragalus* (genuine) remote from its obviously close Californian allies in *Hamosa* sect. *Leptocarpace*. Likewise I can see no close connection between *A. Breweri* and the species with which Jones (1923, p. 284, the fig. on Pl. 71 very poor) associated it in sect. *Didymocarpi*.

LXXIX (vii). Subsectio COAHUILANI

Erect perennials; *vesture* basifixed; *leaflets* 17–27; *flowers* 5–15, loosely or remotely racemose, ascending, smallish, the banner 10–13 (15) mm. long; *calyx-tube* campanulate; *petals* purple, regularly graduated, the keel-tip obtuse; *pod* erect or narrowly ascending, persistent, linear-oblong in profile, slightly incurved; *dehiscence* apical, on the raceme; *ovules* (10) 16–20.—Sp. 1, xerophyte, of Coahuila and northern Zacatecas.

ASTRAGALUS sect. **LEPTOCARPI** subsect. **COAHUILANI**, subsect. nov., a *Pringleanis* legumine persistenti in situ dehiscenti, a *Leptocarpi* genuinis radice perenni absimilies.—Sp. unica: *A. coahuilae* Jones.

The one species of subsect. *Coahuilani* is intermediate between the perennial *Pringleani*, which have similar flowers but promptly deciduous fruits, and the genuine *Leptocarpi*, which have persistent pods dehiscent on the raceme but annual roots. The morphological discontinuities between it and the two other subsections are of about the same order of importance

in the section, so that, if it is included in either related group, the other becomes logically indefensible. It seems best to emphasize the unique features of the Coahuila milk-vetch by placing it in a subsection apart.

332. ASTRAGALUS COAHUILAE

Slender perennial, sometimes flowering the first season and probably never of long duration, with a taproot and (in mature plants) an incipient caudex, rather loosely strigulose with incurved-ascending hairs up to 0.3–0.4 mm. long, the herbage cinereous or greenish, the leaflets bicolored, deeper green and glabrous or nearly so above; *stems* erect and ascending, 1.5–4 dm. long, branched or spurred at 1–several nodes below the middle, floriferous upward from near or above the middle; *stipules* subherbaceous becoming papery, ovate-deltoid or triangular-acuminate, $\pm$ semiamplexicaul, 1–4 mm. long, erect or deflexed; *leaves* (3) 4–11 cm. long, shortly petioled, with (13) 17–27 obovate, elliptic, or oblong, obtuse or retuse-emarginate, flat or marginally involute, more rarely folded leaflets (2) 3–16 mm. long; *peduncles* slender, ascending or incurved, 3.5–14 cm. long; *racemes* loosely or remotely (3) 5–15-flowered, the flowers ascending, the axis early elongating, (1) 3–10 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–2.5 mm. long; *pedicels* ascending, at anthesis slender, 0.8–1.4 mm., in fruit thickened, persistent, 1.5–3 mm. long; *bracteoles* 0–2, minute when present; *calyx* 4.8–6.4 mm. long, strigulose with white or partly black hairs, the slightly oblique disc 0.9–1.2 mm. deep, the tube 3–3.8 mm. long, 1.8–2.7 mm. in diameter, the subulate or lance-subulate teeth 1.8–2.7 (3) mm. long; *petals* pale purple, the wing-tips white; *banner* recurved through $\pm 40^\circ$, rhombic-ovate, -obovate, or -elliptic beyond the cuneate claw, shallowly notched, 10–13 (15) mm. long, 5–8 (9) mm. wide; *wings* 9.6–12 mm. long, the claws 3–4.2 mm., the linear-oblong to narrowly oblanceolate, obtuse, subtruncate, or erose-emarginate, straight or distally incurved blades 6.6–8.5 mm. long, 1.8–2.6 mm. wide; *keel* 6.7–9 mm. long, the claws 3–4 mm., the half-obovate blades 4.3–5.5 mm. long, 2.1–2.8 (3) mm. wide, incurved through $90\text{--}95^\circ$ to the rounded apex; *anthers* 0.45–0.55 mm. long; *pod* erect or ascending at a narrow angle, sessile or nearly so, continuous with the receptacle, linear-oblong in profile, slightly incurved, 1–1.6 cm. long, 2.2–3.3 mm. in diameter, broadly cuneate at base, contracted distally into a short, triangular, cuspidate, unilocular beak, otherwise triquetrous, keeled ventrally by the salient suture, openly grooved dorsally, the lateral faces nearly flat, the thin, greenish, strigulose valves becoming stramineous, rather stiffly papery, obscurely reticulate, inflexed as a complete or almost complete septum $\pm 1\text{--}1.2$ mm. wide; *seeds* brown, sometimes purple-speckled, smooth but scarcely lustrous, 2.1–3 mm. long.—Collections: 6 (i); representative: *Palmer* 234 (GH, K, NY, US), 305 (GH, US, in part); *Purpus* 6511 (UC); *Ripley & Barneby* 13,513 (CAS, NY, RSA, US).

Dry rocky hillsides and boulder-strewn washes, on limestone, $\pm 5600\text{--}6200$ feet, apparently rare, known only from southern Coahuila (near Parras) and northern Zacatecas (Concepción de Oro).—Map No. 150.—February to May; September to November.

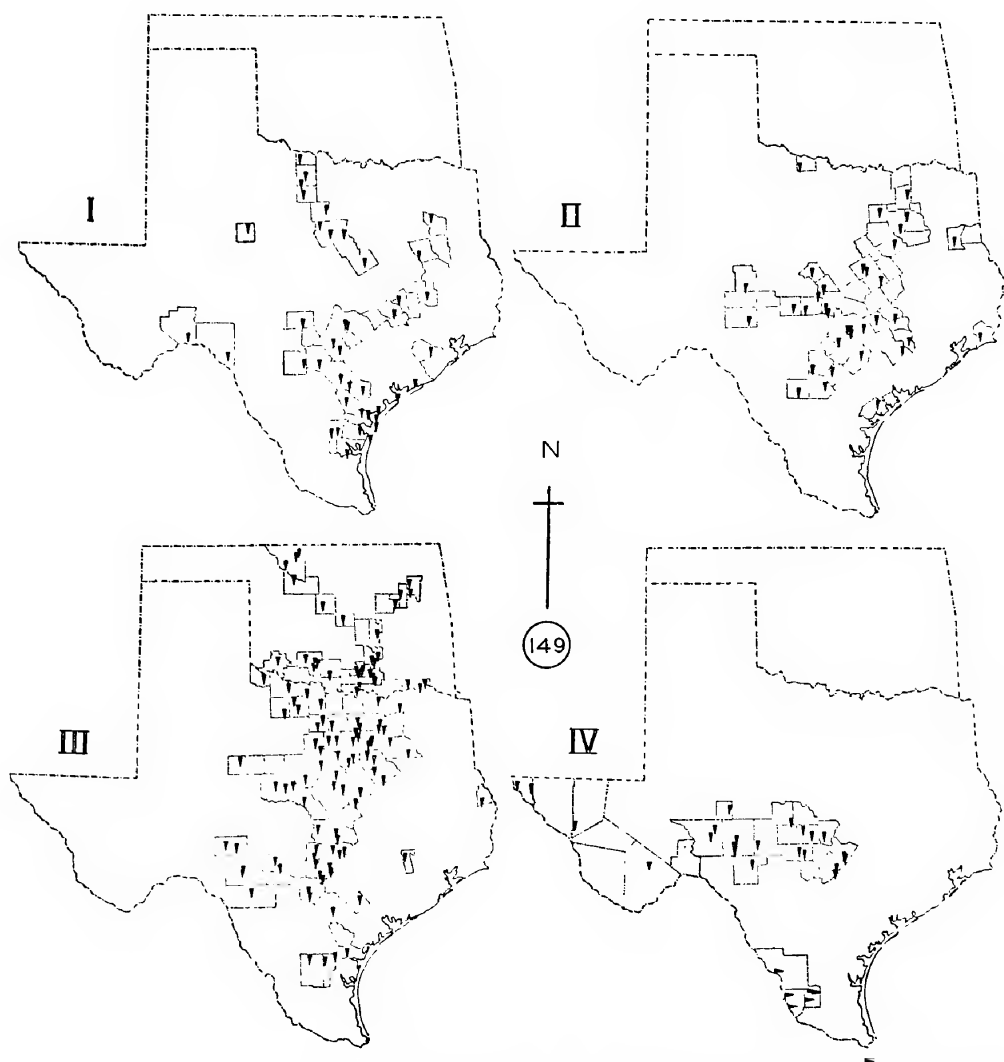
ASTRAGALUS COAHUILAE (of Coahuila) Jones, Rev. Astrag. 256, Pl. 65. 1923 ("*Coahuilae*").—"Parras Coahuila, Nos. 1078 and 4672 Purpus."—Cotypl, collected in March, 1905, and October, 1910, respectively, POM! isotypi, GH (both), UC (both), MO (4672)!—*Hamosa coahuilae* (Jones) Rydb. in Bull. Torr. Club 54: 23. 1927.

The first collection of *A. coahuilae* dates back to 1880, when Edward Palmer discovered the species near Parras. The specimens were misidentified by Watson (in Proc. Amer. Acad. 17: 343. 1882) as an erect form of *A. arizonicus*, a species fundamentally different in its dolabriform pubescence and recognized at a glance by the fewer leaflets of narrower outline

and the acutely triangular keel-tip. The record was repeated by Hemsley in *Biologia Centrali-Americana*, and the error was not fully rectified until much later (Rydberg, 1927, 1. c.). Jones (in herb.) had already changed Watson's determination to *A. nothoxys*, but this species, although technically similar in most respects, is lower and more diffuse in habit of growth, has a (nearly always) appendaged keel-tip, and differs especially in the longer, readily deciduous pod. The Coahuila milk-vetch is the only perennial member of sect. *Leptocarpi* in which the fruit dehisces on the raceme through the gaping beak and not through both ends after falling to the ground. The fruiting raceme recalls that of *A. (Reventi-arrecti) remotus*, but the individual pods are essentially sessile.

LXXIX (viii). Subsectio LEPTOCARPI

Annuals, germinating either in fall or spring, similar to subsect. *Californici* except for the persistent pod; *flowers* 1–12, in one var. of *A. Nuttallianus* sometimes 10–27, loosely but usually shortly or subumbellately racemose, of small or moderate size, the banner 4–18.5 mm. long; *pedicels* persistent; *calyx-tube*



Map No. 149. Oklahoma and Texas. Range (in part) of *A. Nuttallianus*: I, var. *trichocarpus*; II, var. *pleianthus*; III, var. *Nuttallianus*; and IV,  var. *macilentus*, and  var. *zapatanus*.

campanulate; *petals* regularly graduated, the keel-tip either obtuse or acutely triangular; *pod* erect, ascending, or if spreading to somewhat declined then distally incurved-ascending, sessile or stipitate, persistent until dehiscence, the body linear, linear-oblancoelate, or narrowly oblong in profile, compressed-triquetrous, grooved dorsally (or when fully ripe becoming subequally 3-sided or subquadrangular), bilocular or rarely subunilocular, the green valves becoming brown and finally black, papery or thinly leathery; *dehiscence* primarily apical; *ovules* 8–26.—Spp. 3, xerophytes of southwestern United States (southeastern California to Utah, southern Colorado, Oklahoma, and western Arkansas) south to Puebla, Durango, and Baja California, mostly highly diversified in eastern and central Texas.

ASTRAGALUS sect. LEPTOCARPI Jones, Rev. Astrag. 266. 1923, sens. restr.—Sp. lectotypica: *A. leptocarpus* T. & G.—*Hamosa* sect. *Leptocarpace* (Jones) Rydb. in Bull. Torr. Club 54: 321. 1927.

The *Leptocarpi*, in the limited sense of the nomenclaturally typical subsection, consists of the three annual species in which the pod persists on the receptacle until dehiscence, by which time it has ordinarily turned from green through various shades of brown to a dull soot-black. The marcescent fruit is interpreted as the outcome of evolutionary reversal, for these species are highly advanced and specialized and must have reacquired the primitive emmenoloboid character although derived from a piptoloboid parent stock. I have already described an analogous situation in sect. *Argophylli*, a well-defined piptoloboid series which has given rise to one small and clearly specialized emmenoloboid subsect. *Missourienses*. The first two species, *A. leptocarpus* and *A. Nuttallianus*, are closely related; both have small flowers, narrow pods sessile or nearly so, and glabrous styles. The third species, *A. Lindheimeri*, is more isolated, remarkable for its modified flower, puberulent style, and comparatively broad pod contracted at base into a well-developed stipe. However some forms of *A. Nuttallianus* var. *macilentus*, with broad and prominent keel-petals and incipient stipe, demonstrate the path of evolutionary modification which has led up to *A. Lindheimeri*.

The genuine *Leptocarpi* formed part of Gray's sect. *Micranthi*, a heterogeneous group divided by Jones into annual and perennial series. According to Rydberg (1927, p. 321), the epithet *Micranthi* should have been conserved by Jones for the annual group, having been derived from *A. micranthus* Nutt., which is our *A. Nuttallianus* DC. At the time of Gray's revision (1864) the concept of a type-species had not been formulated, and Jones was justified in adapting the name to any dismembered element of the original group. Accordingly I am following Jones and adopting the name *Micranthi* as the earliest sectional epithet for the perennial group equivalent to Rydberg's *Hamosa* sect. *Hartwegianae*.

Key to the Species of Subsect. *Leptocarpi*

1. Flowers relatively small, the banner not over 12 mm., the keel not over 9.5 mm. long, or if the banner rarely up to 13 mm. long, the keel-blades not over 7 mm. long or over 3.2 mm. wide; *pod* (glabrous or pubescent) sessile or nearly so, the stipe when present short and obscure, not over 1 mm. long, the body always narrow, 1.8–3.5 mm. in diameter; *style* glabrous; *ovules* 10–26, commonly over 14 if the flower-size at all critical (2)
2. Flowers of moderate size, the banner about 8.5–12 mm., the keel commonly 6–8 mm. long, its tip acutely triangular; *leaflets* all truncate-emarginate or retuse, green, thinly ciliate or subglabrous; *pod* (glabrous) usually elongate and straight, mostly 2–3.5 cm. long, if curved then gently so its whole length; *ovules* mostly 20–26; e. Texas (? and w. Arkansas) 334. *A. leptocarpus*
2. Flowers variable in size, often much smaller, but if combined in e. Texas with emarginate, green leaflets and acute keel-tip always so, the banner then 4.5–7.3 mm., the keel about 4–5.8 mm. long; *pod* either glabrous or pubescent, but if glabrous in e. Texas then mostly shorter, 1–2.6 cm. long, and commonly arcuate toward the base and straight or nearly so distally (if straight either the keel-tip obtuse or the flowers very small); *ovules* 10–18 (22); widespread in s.-w. U. S. and Mexico 333. *A. Nuttallianus*
1. Flowers larger, the banner (12) 13–18.5 mm., the keel 9.5–13 mm. long, the keel-blades large in proportion to the flower, (7) 7.5–9.5 mm. long, 3.8–5 mm. wide; *pod* stipitate, the stipe (0.8) 1–3 mm. long, the body broader, 3.5–6 (6.5) mm. in diameter; *style* puberulent below the stigma; *ovules* 8–12 (14); Oklahoma and Texas 335. *A. Lindheimeri*

333. *ASTRAGALUS NUTTALLIANUS*

Annuals and winter-annuals, mostly of 3–4 months duration, nearly always quite slender, sometimes diminutive and fugitive, varying from nearly glabrous below the thinly strigulose inflorescence to densely strigulose, villosulous, or pilose with appressed, incurved, or partly (rarely all) spreading, often lustrous hairs up to 0.4–1.35 mm. long, the herbage green, cinereous, or canescent, the leaflets either glabrous or pubescent above; *stems* (1) 2–30 (45) cm. long, 1–several (rarely over 15), when solitary erect, when 3 then the central one erect and the lateral ones incurved-ascending, or these freely branching from near the base and the branches either incurved or prostrately radiating in the form of loosely woven mats, either simple above the base or spurred (branched) at 1–3 nodes preceding the first peduncle, often floriferous from well below the middle; *stipules* (1) 1.5–6 (9) mm. long, the lowest ovate-triangular, early becoming papery, the upper ones triangular- or lance-acuminate to linear-caudate, mostly herbaceous, at least when young, all about semiamplexicaul, or the lowest fully so, but free; *leaves* 1–6.5, rarely 8 (9) cm. long, all slender-petioled or the upper ones often sessile, with (5) 7–19 (23) leaflets varying from linear-elliptic and acute to obcordate, 2–14 (17) mm. long, nearly always flat, all of the same type throughout the plant or dimorphic, those of the lower leaves broader; *peduncles* slender or filiform (0.2) 0.5–9 (10) cm. long, erect or incurved, the early ones sometimes shorter than the later ones and only 1–2-flowered; *racemes* loosely but sometimes subcapitately (1) 2–10 (15), in one var. often 10–27-flowered, the axis not or not greatly elongating, 0–3 cm. (but rarely over 2 cm.) long in fruit, commonly produced beyond the last flower as a subulate appendage; *bracts* submembranous, ovate to lance-acuminate, 0.5–2.5 mm. long; *pedicels* at anthesis 0.4–1 mm., in fruit commonly arched outward, a trifle thickened, 0.5–1.6 mm. long; *bracteoles* 0 (exceptionally a minute scale); *calyx* 2.5–5.7 mm. long, varying from nearly glabrous to densely villosulous or (the teeth especially) pilose, the subsymmetrically campanulate or turbinate disc (0.4) 0.5–1.1 mm. deep, the tube 1.3–2.8 (3.1) mm. long, the teeth varying from subulate to narrowly lanceolate or linear-setaceous, 1–3.2 mm. long, the whole becoming papery, ruptured or not, marcescent; *petals* whitish, pinkish-lilac, pinkish- or amethystine-purple, when brightly colored the banner with a large pale eye, the color turning bluish or violet on drying; *banner* recurved through 40–45°, ovate-, obovate-, or suborbicular-cuneate, shallowly notched, 3.7–10 (13) mm. long; *wings* 3.7–8.6 (10.7) mm. long, the blades oblanceolate to oblong-obovate, obtuse or emarginate, straight or slightly incurved; *keel* 3.7–6.8 (9.3) mm. long, the blades either half-obovate and bluntly deltoid or obliquely triangular to lunately half-ellipsoid, varying according to var. from very obtusely rounded to sharply triangular-acute and porrect; *anthers* 0.2–0.4 (0.6) mm. long; *pod* ascending, spreading, or declined, sessile or contracted at base into a short stipe or obscure stipelike neck up to 0.5–0.9 mm. long, linear or linear-oblanceolate in profile, nearly straight, incurved near the base and straight or nearly so thereafter, or less often evenly and gently incurved its whole length through $\pm \frac{1}{3}$ or even $\frac{1}{2}$ circle, when first formed triquetrously and a trifle laterally compressed, with nearly plane lateral and narrower, shallowly sulcate dorsal faces, the faces becoming flat or slightly convex as the ovules swell, subequally 3-sided or somewhat tetragonal when ripe, the thin, green or purple-tinged, glabrous, strigulose, or villosulous valves becoming papery, stramineous or brownish and ultimately black or nearly so, delicately cross-reticulate, inflexed as a complete septum up to about 2 mm. wide or the septum sometimes incomplete or subobsolete; *dehiscence* apical and downward through the ventral and part-way through the dorsal suture; *ovules* 10–18 (22); *seeds* brown, olivaceous,

or ocher, often purple-dotted, smooth, pitted, or wrinkled, dull or sublustrous, 1.3–2.4 (2.7) mm. long, in the narrowest pods often distorted by crowding.

The small-flowered milk-vetch, *A. Nuttallianus*, embraces a considerable array of distinct forms which have been treated in the past as constituting a complex evidently polymorphic but susceptible or not, according to opinion, to subdivision into varieties, or alternatively as a series of small, closely related species. While maintaining a certain respect for the latter viewpoint, first formulated by Small and elaborated by Rydberg (1927, pp. 325–330; 1929, pp. 429–431), I here follow Gray (1864, p. 199) and Jones (1923, p. 269) in taking a wide and comprehensive view of the circumscription of the species, at the same time rejecting the contention of some contemporary botanists that the component forms are hopelessly confluent and beneath taxonomic notice.

The racial situation within *A. Nuttallianus* is very unusual, the existence of sympatric varieties which occupy the same environment being unique in American *Astragalus*. However, I must first mention the initial difficulties in attempting to organize the now very extensive material to be found in the larger herbaria. Most forms of the species are subject to a good deal of variation common in annual herbs everywhere, both within the limits of a population and from one colony to the next, due to accident of the soil, the season, and the weather. Thus plants growing in light porous soils or loose sands tend to be slender and erect, with a very slender root of short duration, while others nearby in hard-packed clay are comparatively robust, prostrate, and longer-lived. Then young plants flowering within a month to six weeks after germination of the seeds tend to have fewer leaflets to the leaf and few-flowered (often 1-flowered) racemes, and these juvenile characters tend to become perpetuated into the plant's maturity, especially under arid conditions. The same types of variation occur independently in several forms distinguishable by other, sometimes less obviously apparent but more stable characters, and are likely to be mistaken for heritable when they are trivial and superficial in nature. Another difficulty arises from the fact that *A. Nuttallianus* finds a congenial home in sands and gravels along rights-of-way; and there is little doubt in my mind that the pristine patterns of dispersal have become disturbed and deranged during the past fifty years or so. As a result there are confusing records of some varieties occurring far from the known center of their abundance and sometimes within the territory properly belonging to a related form, giving the impression that no geographic rhyme or reason lies behind the polymorphic front. Apart from these exceptions *A. Nuttallianus* is ordinarily represented outside the state of Texas by only one variety in any one place. The vars. *austrinus*, *imperfectus*, *cedrosensis*, and *micranthiformis* are true vicariants, occupying more or less extensive areas of their own and intergrading along the common boundaries. They behave as do the component races of most multiracial astragali and there can be no question that they belong to one species. In western Texas the vars. *macilentus* and *austrinus* are at least partly sympatric, and in east-central Texas the former is joined by vars. *trichocarpus*, *pleianthus*, *Nuttallianus*, and the local var. *zapatanus*. It is astonishing that there is almost no intergradation, even though the vars. *pleianthus* and *trichocarpus* are morphologically confluent when the whole range of variation is examined. In the herbarium I often find two different forms of small-flowered milk-vetch mounted together under one label, suggesting plasticity and random variation (which does occur in a few minor characters), but in the field I have learned to appreciate the uniformity among members of the average population or colony. In eastern Texas it is an easy matter to find two, and not rare to find three varieties of *A. Nuttallianus* growing together under identical conditions and in equal vigor on the same roadside bank or in the same fallow field, sometimes in separate patches but not uncommonly intermingled; yet the individual plants show no sign of hybridization and mass collections from such places can easily be sorted afterward into component categories. The question is bound to arise as to whether the so-called varieties have acquired as a by-product of the original mutation (or subsequently) the intersterility which is commonly accepted as good evidence of differentiation at the specific level. It would be rash to assume that this is so until a genetical study can be made of the whole complex, a study which will be required before a truly sound taxonomic treatment of the group can be had. Moreover, the nearly always small and often inconspicuously colored flowers of *A. Nuttallianus* are certainly capable, in most instances, of self-fertilization and in some forms are semicleistogamous, circumstances which must favor, if they do not actually ensure pure lines of inheritance. However this may turn out, the Texan material could logically be treated as three species, *A. austrinus* (including our vars. *austrinus*, *pleianthus*, *trichocarpus*, and *zapatanus*), the polymorphic *A. macilentus* (possibly further divisible), and *A. Nuttallianus* sens. strict.; for these entities, in Texas, are about equally distinct from one another as our var. *Nuttallianus* is from the nearly related and also sympatric *A. leptocarpus*. The characters useful in the taxonomy of the Texan forms are vesture of the leaves, calyx, and pod, shape of the leaflets, length of the fruiting raceme, size of the flowers, and shape of the keel-tip, although these

are not of equal value in every case. When we extend the field of enquiry to the extra-Texan forms of the species and attempt to apply the same standards of comparison, we begin to encounter vexatious problems. The far western representatives of *A. Nuttallianus* differ one from another in similar ways to the Texan but, as already seen, they are vicariant and intergrade fully. Examining the whole complex, I find no sharp division between forms with acute and others with emarginate leaflets, with flowers of particular size-ranges, or with keel-tip at once very strongly incurved and bluntly rounded as opposed to porrect and triangular-acute. There seems to be no logical alternative to the comprehensive delimitation of *A. Nuttallianus* adopted below.

The centers of greatest complexity and population density of *A. Nuttallianus* coincide with the focus of speciation in subsect. *Leptocarpi*. It seems reasonable to suppose that the whole group is of Texan origin and the western forms of the small-flowered milk-vetch are of comparatively recent origin. Accordingly the varieties are presented in an order of modification starting with var. *Nuttallianus* and passing by small steps into the presumably derived vars. *imperfectus* and *cedrosensis* of the western deserts.

The small-flowered milk-vetch is the commonest annual astragalus with slender pods of the hamosoid type, which is native to the interior southwestern United States and Mexico. Apart from its close relatives in Texas, keyed out above, it is the only one in which the pod remains attached to the receptacle until dehiscence, by which time it has turned from green or purplish-green through stramineous to dark brown or almost black. It is not easy to distinguish all aspects of the species from flowering specimens of *A. Emoryanus*, but difficulty is likely to arise only with var. *macilentus* in which all leaflets are sometimes retuse and the ovary always glabrous. In the deserts of southern Nevada, southeastern California, and Baja California, *A. Nuttallianus* var. *imperfectus* and var. *cedrosensis* are sympatric and sometimes directly associated with *A. acutirostris*, a species formerly included within *A. Nuttallianus* which may be recognized, before the deciduous, commonly resupinate pod has formed, by the loose racemes and by leaflets obcordate or emarginate in all (even the uppermost) leaves. The rare *A. nyensis*, endemic to southern Nevada and also first described as a variety of *A. Nuttallianus*, is sympatric with var. *imperfectus*, but is more easily recognized at flowering time by its densely hirsutulous vesture and again by the emarginate leaflets.

It seems appropriate to mention here my indebtedness to the able Texan botanists Dr. Shinnars (SMU), Dr. Turner (TEX) and Dr. Warnock (SRSC) for loans and gifts of pertinent material. Any merit which the present account of the *A. Nuttallianus* complex may possess must be attributed to the uniquely rich materials that they and their predecessors have assembled and that they so generously made available for leisured study.

Key to the Varieties of *A. Nuttallianus*

1. Leaflets of all leaves retuse or truncate-emarginate (2)
 2. Ovary and pod glabrous, or if pubescent only minutely strigulose; flowers variable in size but if very small, with banner less than 6.5 mm. long, then the herbage minutely strigulose or subglabrous; widespread in Oklahoma and Texas (3)
 3. Flowers small, the banner 4.3–7.3 (7.6) mm., the keel-tip triangular-acute or sharply deltoid; raceme-axis not elongating or scarcely so, not over 0.8 (1) cm. long in fruit; Oklahoma to s.-centr. and e. Texas 333a. var. *Nuttallianus*
 3. Flowers larger, the banner 8.5–13 mm. long, the keel-tip obtusely rounded (if acute, cf. *A. leptocarpus*); raceme-axis mostly elongating and 1–3 cm. long in fruit; centr. and w. Texas 333c. var. *macilentus*
 2. Ovary and pod pubescent, the pod loosely strigulose and the herbage hirsutulous; flowers very small, the banner about 5–6 mm. long; local in s. Texas and adjacent Tamaulipas 333i. var. *zapatanus*
1. Leaflets not all retuse or truncate-emarginate, elliptic or ovate and obtuse to subacute in at least some upper, often all leaves (4)
 4. Keel obtusely rounded at tip; racemes elongating, the axis mostly 0.5–3 cm. long in fruit; Texas, or the Colorado Basin to n. New Mexico and s.-e. Colorado. Pod commonly glabrous (5)
 5. Flowers small, the banner not over 7.6 mm. long; s. Colorado Basin to n. New Mexico and s.-e. Colorado 333b. var. *micranthiformis*
 5. Flowers larger, the banner 8.5–13 mm. long; centr. to w. Texas 333c. var. *macilentus*
 4. Keel triangular or narrowly deltoid at tip, acute or subacute, commonly porrect; racemes not or scarcely elongating, up to 0.8 (1.2) cm. long in fruit; widespread. Pod glabrous, strigulose, or villosulous (6)
 6. Calyx pubescent with relatively long hairs, up to (0.65) 0.7–1.2 mm. long, the teeth (1.5) 1.8–2.8 (3) mm. long, hispid-ciliate; intergradient and some-

times not clearly distinguished (7)

7. Flowers relatively large, the banner mostly 7–9 mm. long, *racemes* mostly 4–10-flowered; *pod* consistently glabrous; e. Texas from Red River to Edwards Plateau and the Sabine River mostly below 1500 ft. 333d. var. *pleianthus*
7. Flowers small, the banner mostly 5–7 mm. long; *racemes* mostly 1–5 (6)-flowered; within the range of the last *pod* nearly always pubescent (8)
8. *Pod* hirsutulous, the hairs 0.5–1 mm. long; *leaflets* commonly 11–13; e. Texas, mostly on the Coastal Plain 333e var. *trichocarpus*
8. *Pod* glabrous or strigulose, if pubescent the hairs shorter, appressed, 0.5 mm. long or less; *leaflets* commonly 7–11; widely dispersed from centr. Texas to s. Oklahoma, s.-centr. Arizona, and Puebla, mostly above 1500 feet 333f. var. *austrinus*
6. *Calyx* strigulose, or more shortly hirsutulous with appressed or narrowly ascending hairs up to 0.35–0.8 mm. long, the *calyx-teeth* shorter, 1–1.7 (2) mm. long, not hispid-ciliate; western deserts, s. and centr. Arizona to Utah, n. Sonora, s.-e. California and Baja California (9)
9. *Leaflets* subhomomorphic, all elliptic, those of the upper leaves sometimes longer and narrower than those of the lower ones but none retuse or emarginate; *calyx-tube* deeply campanulate, 1.9–2.8 mm. long, about half as broad; e. Mohave Desert, California, to Utah and w. and centr. Arizona 333g. var. *imperfectus*
9. *Leaflets* dimorphic, those of the lowest leaves small and retuse, those of the upper ones elliptic and acute; *calyx-tube* shallowly campanulate, 1.4–1.7 mm. long and about as broad; Colorado Desert, California, to Baja California and n. Sonora 333h. var. *cedrosensis*

333a. ASTRAGALUS NUTTALLIANUS var. NUTTALLIANUS

Thinly strigulose with fine, appressed or subappressed hairs up to 0.4–0.65 (0.7) mm. long, the herbage dark green, the leaflets glabrous above; *stems* (0.2) 0.5–3 (4) dm. long; *leaves* 2–6 (7.5) cm. long, with (7) 11–19 (23) linear-oblong, oblong, oblong-cuneate, or ovate-cuneate, retuse or truncate-emarginate, or in some lower leaves obcordate leaflets (2) 4–14 (17) mm. long; *peduncles* 2–7 (8.5) cm. long; *racemes* subcapitately (1) 2–6 (7)-flowered, the axis not or scarcely elongating, not over 8 (10) mm. long in fruit; *calyx* (3.5) 3.7–5.4 mm. long, thinly strigulose with black, mixed, or white hairs, the pallid or sometimes purplish tube 1.3–2.4 mm. long, 1.3–1.8 mm. in diameter, the lanceolate or linear-lanceolate, herbaceous teeth (1.7) 1.9–3.2 mm. long; *petals* reddish- or amethystine-purple with a pale, striate eye in the banner, drying violet; *banner* (4.3) 4.8–7.3 mm. long, (2.6) 3.4–5.5 mm. wide; *wings* 4.7–6.7 mm. long; *keel* (3.8) 4.3–5.8 mm. long, the claws (1.4) 1.7–2.2 (2.4) mm. the lunately half-elliptic blades 2.5–3.6 (3.9) mm. long, 1.3–2.2 mm. wide, incurved through 80–95° to the acutely triangular or sharply deltoid, erect or porrect apex; *pod* declined, deflexed, or spreading and incurved-ascending, sessile, (1.2) 1.6–2.6 cm. long, (2) 2.4–3.5 mm. in diameter, nearly straight or gently incurved, but if curved usually only in the lower fourth and nearly straight thereafter, at first compressed-triquetrous but often becoming tetragonous when fully ripe, the valves glabrous, the septum complete, 1.3–2 mm. wide; *ovules* 10–16.—Collections: 147 (xi); representative: *A. & R. Nelson 1016* (SMU, TEX); *Bush 1019* (ND, NY); *Cory 55,695* (SMU, WS); *Ruth 12* (NY, SMU, WIS); *Shinners 9265* (OKLA, SMU), *10,972, 14,218, 18,547* (SMU); *Ripley & Barneby 4123, 11,057, 11,066* (CAS, RSA).

Prairies, stony or sandy pastures, roadsides, and open pine or oak woods, mostly below 2000 feet, in various types of light and heavy soils, perhaps most abundant on limestones, widespread and locally very common from northeastern and northcentral Oklahoma and western Arkansas south to southern Texas (Duval, Jim Wells, and San Patricio Counties), west in Oklahoma to the south-

west corner of the state and in Texas to Nolan County and the Edwards Plateau in Sutton and Uvalde Counties, east in Texas almost to the Sabine River, but rare and scattered on the Coastal Plain.—Map No. 149.—March to June.

ASTRAGALUS NUTTALLIANUS (Thomas Nuttall, 1786–1859) A. DC., Prod. 2: 289. 1825, a substitute for *A. micranthus* (small-flowered) Nutt. in Jour. Acad. Philad. 2: 122. 1821 (non Desv., 1814).—"On the plains of Red River," and cultivated in the garden of the University of Pennsylvania.—Holotypus, labeled by Nuttall "*Astragalus *Nuttallianus*. Red River.," PH! isotypi, G, K, and labeled "Arkansa, Nuttall.," BM, K, NY!—*Tragacantha micrantha* (Nutt.) O. Kze., Rev. Gen. 941. 1891. *Hamosa Nuttalliana* (A. DC.) Rydb. ap. Small, Fl. S.E. U. S. 1332. 1903.

Astragalus Nuttallianus var. *enneajugus* (with eleven pairs of leaflets) Jones, Contrib. West. Bot. 8: 22. 1898.—"Prairies of the Brazos, Tex., March 1844, Lindheimer . . ."—Cotypi, MO Nos. 17,072, 17,073, MO!

Astragalus Nuttallianus var. *quadrilateralis* (four-sided, of the pod) Jones, Contrib. West. Bot. 8: 22. 1898.—"Northwestern Arkansas from Caneyhill to Fort Gibson, on damp prairies, June 1835, Engelmann . . . Indian Territory, Butler 1875 . . ."—Lectotypus, *Engelmann s. num.*, MO No. 17,074, MO!

The typical variety of small-flowered milk-vetch, var. *Nuttallianus*, is easily recognized by its consistently retuse or at least truncate-emarginate leaflets of a dark green color, by the calyx with its short, pale or purplish tube and long, slender, green teeth sometimes nearly as long as the banner, and by the glabrous pod commonly curved at base and straight thereafter but sometimes straight throughout. Apart from trivial variations in stature and orientation of the stems, it is perhaps the most constant and best characterized phase of the species. The pod varies in direction according to the attitude of the stems, being declined or deflexed from erect peduncles and spreading or incurved-ascending from procumbent branches. In Texas it is associated in places with var. *trichocarpus*, distinguished by pubescent pod, and var. *pleianthus*, differing in leaflet-shape and slightly larger flowers, and also with *A. leptocarpus* which it resembles closely in many ways, although easily separated by its much smaller flower and shorter pod containing 5–8 and not (9) 10–13 pairs of ovules or seeds.

As already pointed out by Rydberg (1927, p. 325), the epithet *Nuttallianus* was misapplied by Jones (1923, p. 270) to a complex of western forms corresponding with our vars. *imperfectus*, *micranthiformis* and *austrianus*, and the substance of the variety treated as vars. *enneajugas* and *quadrilateralis*. Both of these varieties were based on characteristic examples of var. *Nuttallianus*, the typus of var. *enneajugas* being a rather robust specimen in flower, that of var. *quadrilateralis* a specimen bearing ripe fruits which had become, as happens normally, distended by pressure of the expanding seeds and bluntly tetragonal.

The variety has been reported from Arkansas since early times, but I have no exact record of locality. Nuttall's plant at New York is labeled simply "Arkansa," and the one at Philadelphia "Red River"; they may have originated in the southwest corner of the state. The type-locality of var. *quadrilateralis* was given as being in Arkansas, but Caneyhill lies only a few miles east of the Oklahoma line (in western Washington County) and Fort Gibson some forty miles west of it, on the Arkansas River. Likewise Fort Towson, although in Arkansas Territory when visited by Leavenworth, is situated in present-day Oklahoma (Choctaw County) and not in Arkansas as said by Rydberg (1927, 1.c.).

333b. *ASTRAGALUS NUTTALLIANUS* var. *MICRANTHIFORMIS*

Habit and general appearance of var. *Nuttallianus*, the herbage dark green, thinly pilosulous with narrowly ascending or subappressed hairs up to 0.45–0.7 (0.8) mm. long, the leaflets glabrous or nearly so above; stems erect, ascending, or prostrate, 3–18 (25) cm. long; leaves 1.5–4.5 (6.5) cm. long, with (7) 9–15 leaflets 2–10 mm. long, those of the lower leaves obovate or oblong, retuse or emarginate, or obcordate, those of the upper leaves mostly longer, oblanceolate, elliptic, or linear-oblong, all or at least the lateral ones obtuse to subacute, the terminal one sometimes emarginate; peduncles (1.5) 2.5–5.5 (6.5) cm. long; racemes loosely (1) 3–7-flowered, the axis early elongating, (0) 0.5–2 cm. long in fruit; calyx 3.4–4.7 mm. long, loosely strigulose with mixed black and white, all black, or all white hairs up to 0.4–0.7 mm. long, the tube 2–2.8 mm. long, (1.5) 1.7–2.2 mm. in diameter, the teeth (1.2) 1.5–2.2 (2.5) mm. long; petals bright purple, the banner with a large pale eye; banner 6.3–7.6 mm. long, 4–6

mm. wide; *wings* 4.9–6.5 mm. long; *keel* 4.5–5.9 mm., the claws 1.8–2.3 mm., the half-obovate blades (2.6) 3–4.1 mm. long, 1.6–2 mm. wide, abruptly incurved through 90–95° to the blunt apex; *pod* spreading or declined, sessile or nearly so, the body (1.2) 1.4–2 cm. long, 2.1–3.3 mm. in diameter, evenly and gently incurved through about $\frac{1}{4}$ – $\frac{1}{2}$ circle, the glabrous or minutely strigulose valves inflexed as a complete septum 1.3–1.8 mm. wide; *ovules* 13–17.—Collections: 30 (vii); representative: *Holmgren* 3186 (NY, RSA, TEX, WS, WTU); *Crandall* 784 (NY, WS); *Eastwood* 5962 (CAS); *Ripley & Barneby* 5293 (CAS, RSA), 7559 (RSA, UTC), 8485 (RSA).

Dry sandy or stony hillsides, sandy talus beneath cliffs, rocky canyon washes, sometimes on dunes, commonly with piñon and juniper, mostly on sandstone or limestone, widespread, mostly between 4200 and 6200 feet, in the south and south-east parts of the Colorado Basin, from Grand Canyon (where descending to 3500 feet), Arizona, to Green River, Utah, and southwestern Colorado, extending less frequently to the Rio Grande Valley in northcentral New Mexico, and (perhaps interruptedly) thence northeast to the Arkansas River in southeastern Colorado.—Map No. 150.—April to June.

ASTRAGALUS NUTTALLIANUS var. *MICRANTHIFORMIS* (resembling *A. micranthus* Nutt. = var. *Nuttallianus*), var. nov. inter var. *Nuttallianum* et var. *austrinum* quasi intermedia, illi propior, a prima dentibus calycinis brevioribus, racemo fructifero laxo, foliis dimorphis (saltem lateralibus foliorum superiorum acutiusculis nec retusis), et legumine valde arcuato, a secunda et affinis racemo laxo carinaque abrupte incurva obtusissima dissimilis.—COLORADO: sand in the piñon belt, 5900 ft. Towaoc, Montezuma County, May 29, 1947, *Ripley & Barneby* 8390.—Holotypus, CAS! isotypus, RSA!

The first collection of var. *micranthiformis* from the Colorado Basin, Crandall's plant from Grand Junction, Colorado (1898, cited above), was referred by Rydberg (1927, p. 326) to *Hamosa Nuttalliana*, our var. *Nuttallianus*, which was not known otherwise to extend west of Oklahoma and central Texas. Possibly Rydberg interpreted the occurrence as a chance introduction, but we now possess many examples of a similar plant from the Four Corners country and upper Rio Grande in New Mexico, unquestionably native, which match Crandall's plant in the deep green, thinly pubescent foliage, several or many (but never all) retuse or truncate-emarginate leaflets, and obtusely rounded keel-tip. The var. *micranthiformis* does resemble var. *Nuttallianus* in general mien and foliage, but its pod is ordinarily incurved its whole length (and not only at base) through $\frac{1}{4}$ to nearly $\frac{1}{2}$ circle, the calyx-teeth at least relative to the tube are decidedly shorter, and the raceme elongates substantially as the flowers fade. The variety is most strongly marked in the drainage of the Colorado River upstream from Grand Canyon, in which area it is the only form of *A. Nuttallianus* known to occur. A collection from the Arkansas Valley in Crowley County, southeastern Colorado (*Ripley & Barneby* 8301, RSA) is geographically and morphologically intermediate between var. *micranthiformis* and var. *Nuttallianus*, having the calyx nearly of the latter, but the pod and leaflets of the present form. Immediately south of the Mogollon Escarpment in Gila County, Arizona, forms of *A. Nuttallianus* intermediate between var. *micranthiformis* and var. *austrinus* are apparently not uncommon. For example, *Eastwood* 16,876 (CAS) combines an obtuse keel-tip with leaflets all elliptic, and *Barneby* 12,647 (RSA) a subacute keel-tip with retuse leaflets. Since var. *micranthiformis* evidently intergrades with both var. *Nuttallianus* and var. *austrinus*, and at the same time has a blunt keel-tip in common with var. *macilentus*, it serves to link together the three principal morphological types in the specific complex and is thus crucial to the taxonomy of the group.

Although only recently recognized as a distinct form, var. *micranthiformis* was first collected as early as 1847 by Fendler (No. 165, MO) on the banks of the Rio Grande near Santa Fe.

333c. *ASTRAGALUS NUTTALLIANUS* var. *MACILENTUS*

Variable in stature, robust or quite slender, strigulose-pilosulous with appressed, narrowly ascending, or incurved hairs up to 0.2–0.8 mm. long, the herbage green or cinereous, the leaflets glabrous or thinly pubescent above; *stems* mostly erect or ascending, rarely diffuse, 0.8–3 (3.8) dm. long; *leaves* (1.5) 2–9.5 cm. long, with 7–23 linear-elliptic, oblong-ob lanceolate, broadly elliptic,

or obovate leaflets 3–15 mm. long, these all acute, all obtuse, rarely all-truncate-emarginate, or variably dimorphic, those of the upper leaves then narrowest; *peduncles* 2.5–9 cm. long; *racemes* loosely (2) 3–27-flowered, the axis nearly always somewhat elongating, (0.5) 1–3 cm. long in fruit; *calyx* 3.4–5.6 mm. long, thinly pubescent like the herbage with either black or white hairs, the tube 2–3.1 mm. long, 1.7–2.3 mm. in diameter, the subulate or linear-subulate teeth 1.1–3 mm. long; *petals* pale purple, or whitish with banner margined and keel tipped with lilac; *banner* (6.4) 8.5–13 mm. long, (4) 5–8.6 mm. wide; *wings* (6.1) 6.7–10.7 mm. long; *keel* (5) 5.4–9.3 mm. long, the claws 1.8–3.5 mm., the half-obovate blades (3.5) 3.7–7 mm. long, 1.8–3.2 mm. wide, abruptly incurved through 85–100° to the bluntly deltoid apex; *pod* ascending (commonly at a wide angle), spreading, or sometimes declined, contracted at base into a necklike stipe 0.3–0.9 mm. long, the body linear or linear-oblongate in profile, (1) 1.3–2.5 cm. long, 1.8–2.7 mm. in diameter, a little incurved at base and straight thereafter or gently incurved throughout, the green or purplish valves glabrous; *ovules* 12–22.—Collections: 28 (o); representative: *L. B. Smith* 33,358 (SMU, TEX); *Cory* 39,038 (TEX); *Reverchon* 1637 (NY, MO); *Rose-Innes & Warnock* 812 (SMU, TEX); *Turner & Marshall* 2510 (CAS, GH, RSA, TEX, US); *G. L. Fisher* 40,085 (CAS); *Sperry* (from Llano) in 1950 (ARIZ, CAS, WS).

Dry rocky hillsides, gravelly flats, and in disturbed soil along roads and railways, sometimes on gravel bars of summer-dry streams, apparently local but abundant locally in favorable years, especially in calcareous soils but not confined to them, southcentral Texas, from the Balcones Escarpment west across the Edwards Plateau nearly to the Pecos River, also in scattered stations west to El Paso.—Map No. 149.—March to May.

ASTRAGALUS NUTTALLIANUS var. *MACILENTUS* (Small) Barneby ap. B. L. Turner, Legum. Tex. 199. 1959, based on *Hamosa macilenta* (mean or meagre, descriptive of the *typus*) Small, Fl. S. E. U. S. 618, 1332. 1903.—“Type, along the Rio Blanco, Texas, *Wright* in herb C. U.”—Holotypus, collected in 1850, NY! isotypus, GH!—*Astragalus macilentus* (Small) *Cory* in *Rhodora* 38: 406. 1936.

The var. *macilentus* as defined above is perplexingly polymorphic, the populations differing greatly one from another in number and shape of leaflets and in number and size of flowers. The nomenclaturally typical phase is apparently a rare thing. It is characterized by its short leaves composed of 3–5 pairs of leaflets, elliptic and acute or subacute in all leaves, and by racemes of about 3–7 comparatively small flowers, with banner 8.5–10 mm. long. Curiously enough the modern collections from trans-Pecos Texas match *Wright's typus* better than do most specimens collected subsequently in eastern Texas. The common phase of var. *macilentus* on Edwards Plateau is a more leafy plant with up to 7–9 pairs of leaflets, these truncate-emarginate in all or most leaves; the flowers are essentially as in the preceding. About the east end of the variety's range, in a restricted area extending from Hays and Travis Counties northwest to Mason, McCulloch, and Lampasas Counties, one encounters a robust form with some 7–11 pairs of leaflets varying in width and outline and either obtuse or subacute, combined with racemes of about 10–27 distinctly larger flowers, with banner 9.5–13 mm. and prominent keel 7–9.3 mm. long. Interestingly enough the increased length of the petals is not usually accompanied by a longer or larger calyx, and so the flowers are somewhat differently proportioned. This unusually handsome phase of the small-flowered milk-vetch appears quite distinct in its extreme form and during preliminary studies I annotated specimens as an unpublished variety; subsequently I have seen many intermediate states in flower-size and -number, and think it is better disposed of as a minor variant. I should add that the anthers of the large-flowered variant are substantially longer (mostly 0.45–0.6, not 0.3–0.45 mm.) than in the prevailing states of var. *macilentus*. Plants of extremely slender build, with exceptionally small flowers and short pods (described in parentheses above), represent the variety on granitic or metamorphic soils at Enchanted Rock in Llano County (*Tharp* in 1938; *Rowell & Barkley* 177286, both TEX); for the present they are likewise treated as a minor variant, but they will repay further study. They might be compared to the small-flowered states of *A. leptocarpus*.

The var. *macilentus* is the only Texan variety of *A. Nuttallianus* with blunt keel-tip. It almost always has much larger flowers than var. *Nuttallianus* and shorter pubescence, es-

pecially on the calyx, than the rather similar and partly sympatric var. *pleianthus*. The phase with large flowers is suggestive of the smallest-flowered forms of *A. Lindheimeri* as far as the individual flower is concerned, but the latter species is easily distinguished at anthesis by its short, few-flowered racemes and puberulent style, and later, of course, by the much broader, stoutly stipitate pod. When of average size the flower of var. *macilentus* closely resembles that of *A. Emoryanus*, of which the keel-tip is also bluntly deltoid; and when the leaflets are also all truncate-emarginate, the two species are difficult to tell apart until the fruit has formed. The pod of var. *macilentus* is contracted at base into a short stipe or stipelike neck and persists until dehiscence, that of *A. Emoryanus* is exactly sessile and deciduous when ripe. Rydberg's records of *Hamosa macilenta* (1927, p. 327) from Mexico are based on specimens of *A. Emoryanus*, a species which he described but largely misunderstood. Jones's reduction (1923, Index) of *H. macilenta* to *A. leptocarpus* could not have happened if he had examined the holotypus at NY.

333d. *ASTRAGALUS NUTTALLIANUS* var. *PLEIANTHUS*

Variable in stature but usually vigorous and leafy, strigulose or hirsutulous with subappressed or ascending, mostly straight, lustrous hairs up to 0.65–1.35 mm. long, cinereous or greenish, the leaflets pubescent on both sides, sometimes thinly so, very rarely glabrous above; *stems* mostly 1–3 (4.5) dm. long; *leaves* 1–6.5 (8) cm. long, with 13–17 (21) rather broadly elliptic leaflets 2–13 (15) mm. long, those of the upper leaves subacute or obtuse, those of the lower ones obtuse or emarginate; *peduncles* either longer or (the earlier ones especially) shorter than the leaf; *racemes* subcapitately 4–9 (12)-flowered, the axis not or scarcely elongating, up to 8 (12) mm. long in fruit; *calyx* mostly 4–5.4 (5.7) mm. long, hirsute or hirsutulous with rather stiff, straight, lustrous (white or partly black or fuscous) hairs up to (0.6) 0.65–1.2 mm. long, the tube 2–3.1 mm., the teeth mostly 1.8–2.8 (3.1) mm. long; *petals* purple, the banner with a large, whitish eye; *banner* suborbicular-cuneate, mostly 7–9 (9.5) mm. long; *keel* mostly 5–6.6 mm. long, the blades lunately half-elliptic, incurved through 50–90° to the triangular, acute or subacute, nearly always porrect apex; *pod* sessile or contracted at base into an obscure stipelike neck up to 0.5 mm. long, mostly 1.3–2.4 cm. long, 1.8–2.8 (3) mm. in diameter, arched most strongly near the base and straight or nearly so thereafter, the valves glabrous, inflexed as a complete septum 0.9–2 mm. wide; *ovules* 14–18 (20).—Collections: 52 (iii); representative: mentioned below.

Prairies, roadsides, and open woodlands, mostly below 1500 feet, locally abundant and rather common in central and southeastern Texas, extending west to Edwards Plateau in Sutton County, south (but less common) to the Coastal Plain in Refugio County, north (becoming rarer) nearly to the Red River.—Map No. 149.—March to May.

ASTRAGALUS NUTTALLIANUS var. *PLEIANTHUS* (Shinners), comb. nov., based on *A. austrinus* var. *pleianthus* (with more and larger flowers) Shinners in Field & Lab. 25: 33. 1957.—“... 5.7 miles south-southeast of Richland, Navarro Co. [Texas], Shinners 22,900, 28 April, 1956 ...”—Holotypus, SMU, not examined; isotypus, GH!

With var. *pleianthus* I begin to take up the forms of small-flowered milk-vetch with subcapitate racemes, acute keel-tip, and at least some leaflets rounded or acute and not truncate-emarginate at apex. Over the greater part of its range var. *pleianthus* is sympatric and often directly associated with var. *Nuttallianus*, var. *trichocarpus*, and the blunt-keeled var. *macilentus*. It resembles var. *Nuttallianus* in the glabrous pod but is easily distinguished by the shape of the nearly always more densely pubescent leaflets, hirsute or hirsutulous calyx, and decidedly larger flowers. It is apparently more closely related to var. *trichocarpus*, the hairy legume of which is the most convenient (although in the context unimportant) differential character, but the flowers of var. *trichocarpus* are also, at least on the average, smaller and fewer and the petals tend to be paler in coloring. Along its west edge the range of var. *pleianthus* overlaps that of the smaller-flowered var. *austrinus*, in which the pod varies from glabrous to strigulose; but the form with glabrous fruit has not been recorded from so far east. My concept of var. *pleianthus* is embodied in the extensive series of specimens built up by Dr. Shinners at SMU

and the scarcely less important series at TEX; they were annotated during my preliminary studies of the complex as *A. Nuttallianus* var. *trichocarpus* γ.

333e. ASTRAGALUS NUTTALLIANUS var. TRICHOCARPUS

Somewhat intermediate between the preceding and the following varieties, but with smaller flowers than var. *pleianthus* and pubescent pod, the hairs mostly longer than in var. *austrinus* and incurved-ascending, up to 0.5–1 mm. long; *leaflets* mostly 11–13 and broadly elliptic, exceptionally emarginate in some lower leaves; *racemes* (1) 3–6-flowered; *banner* (4) 5–7 mm., keel (as in the preceding) mostly 4–5 mm. long.—Collections: 53 (iii); representative: all at SMU & TEX annotated by me as *A. Nuttallianus* var. *trichocarpus* δ; *Lindheimer* 748 (NY); *Tracy* 9109 (MO, NY, TEX, WIS); *A. Heller* 1380 (NY, WS).

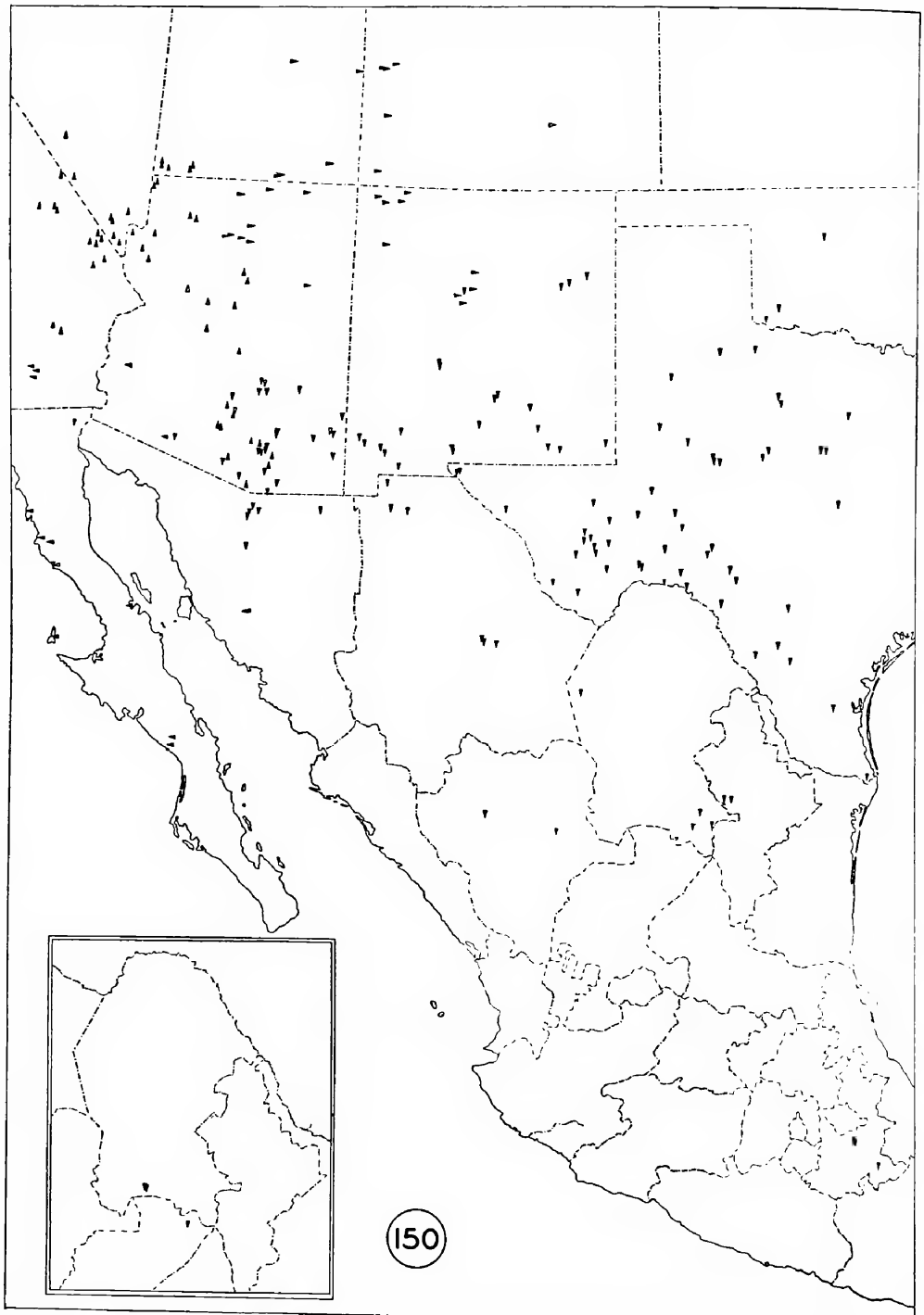
Habitats of the preceding, and of almost coextensive range in eastern Texas, most abundant on and near the Balcones Escarpment and Gulf Coastal Plain, extending to the coast between Matagorda Bay and Corpus Christi, north, becoming less frequent, almost to the Red River, passing west into var. *austrinus* west from central Edwards Plateau.—Map No. 149.—March to May.

ASTRAGALUS NUTTALLIANUS var. (β) TRICHOCARPUS (with hairy pods) T. & G., Fl. N. Amer. 1: 333. 1838.—“Texas, Drummond!”—Holotypus, from Drummond’s Collection I, NY! isotypi, some dated “1833,” others “1834,” BM, G, OXF!—*A. trichocarpus* T. & G. ex M. J. Young, Fam. Less. Bot. with Fl. Tex. 228, 1873, probably an inadvertent comb., due to faulty copying from Fl. N. Amer. (non Grah. ex Bth. in Royle, Ill. Himal. 199. 1835).

The var. *trichocarpus* is taken up in a sense much more restricted than was foreseen in my naive note (1942, p. 109) on the western varieties of *A. Nuttallianus*, where my concept, derived from Rydberg, was substantially equivalent to var. *austrinus* of these pages but included the bilocular element of var. *imperfectus*. The name is here more narrowly applied to those eastern and central Texan forms of small-flowered milk-vetch that differ from sympatric varieties in their pubescent ovaries, and from the forms of var. *austrinus* with strigulose pods, found mostly at higher elevations from western Texas westward and southward, in the longer and looser vesture of the ripe fruit, the commonly more robust and leafy growth-habit, and mostly broader and slightly more numerous leaflets to the average leaf. The meridian drawn through San Angelo, Texas, approximately coincides with the west limit of var. *trichocarpus*, while typical var. *austrinus* (except for isolated records in southern Texas noted below as probable introductions of recent date) extends only rarely and for no great distance east of this line. As might be expected, the two varieties are not clearly distinguished where their ranges of dispersal overlap. The holotypus of var. *trichocarpus* is not the extreme phase of its sort, the hairs on the pod being subappressed and only just 0.5 mm. long. Its exact point of origin is not recorded, but it is most closely matched by modern collections from eastcentral Texas. As already implied, var. *trichocarpus* as redefined formed part of *Hamosa austrina* sensu Rydberg (1927, p. 329; 1929, p. 431) and of var. *austrinus* as accepted by Shinnars (in Field & Lab. 25: 33. 1957).

333f. ASTRAGALUS NUTTALLIANUS var. AUSTRINUS

Usually very slender, often diminutive and fleeting, the stems mostly (0.1) 0.3–2.5 (3.5) dm. long, the herbage gray- or silvery-strigulose or -hirsutulose, often densely so; *leaves* 1–6.5 cm. long, with about 7–11 small, narrowly elliptic leaflets, those of the lowest leaves sometimes broader but never truncate-emarginate; *racemes* mostly (1) 2–5 (7)-flowered; *calyx* mostly 3.7–5.4 mm. long, the teeth silvery-pilose with lustrous, spreading hairs mostly over 0.65 mm. long; *petals* whitish or pale purple; *flowers* as in the preceding two varieties but always small, the *banner* (4) 5.5–7 mm. long; *pod* as in var. *pleianthus* but either glabrous or strigulose with closely appressed hairs up to 0.5 mm. long.—Collections: 113 (xiii); representative: *A. & R. Nelson* 1438 (NY, SMU); *Metcalf* 1531 (CAS, NMC); *Barneby* 12,592 (CAS, RSA); *Waterfall* 7800 (OKLA, TEX); *B. L. Turner* 838 (SMU, SRSC); *Cory* 53,400 (SMU, WS); *Earle & Tracy* 190



Map No. 150. Parts of southwestern United States and Mexico. Range (in part) of *A. Nuttallianus*: $\blacktriangle$ *var. austrinus*; $\blacklozenge$ *var. imperfectus*; $\blacksquare$ *var. micranthiformis*; and $\bullet$ *var. cedrosensis*. The hollow triangles denote intergradient forms. Inset, lower left, Coahuila and parts of adjoining states. Range of *A. coahuilae*.

(NY); *Palmer* 26 (NY, US); *Hartman* 595 (NY, US); *Pringle* 276 (NY, US), 853 (NY); *Arsène* 3622 (US).

Dry plains and hillsides, sometimes abundant along roadsides, in various types of dry, heavy or porous soils, especially common and vigorous on limestones, mostly above 2000 and up to 7000 feet (lower only in isolated stations eastward), widespread and common nearly throughout the Pecos Valley, western Texas and eastern New Mexico north to Quay and Guadalupe Counties, north through westcentral Texas into southwestern and Panhandle Oklahoma, west through southern New Mexico (and north along the Rio Grande rarely to Albuquerque) into southeastern Arizona, south into northeastern Sonora, Durango, and Nuevo León; apparently isolated on dry limestone hills, about 6500 feet, in Puebla; also, perhaps adventive from farther west, in sandy ground at low elevations in southern Texas (Kenedy County).—Map No. 150.—March to May, sometimes again in summer or fall in areas of summer rainfall.

ASTRAGALUS NUTTALLIANUS var. *AUSTRINUS* (Small) Barneby ap. Shreve & Wiggins, Veg. Fl. Son. Des. 709, 1964, based on *Hamosa austrina* (southern) Small, Fl. S.E. U. S. 618, 1332. 1903.—“Type, Rio Fronteras, Texas, *Thurber*, no. 417, in Herb. N. Y. B. G.”—Holotypus, collected in June, 1851, NY! isotypi, giving the state as Sonora (not Texas, as inferred without basis by Small), GH, NY!—*Astragalus austrinus* (Small) Schulz, Five Hundred Wild Fl. San Antonio 104. 1922.

Astragalus Nuttallianus var. *canescens* T. & G. ex Wats., Bibl. Ind. 198. 1878, nom. confus. (vide infra).

Astragalus subuniflorus (about 1-flowered) Greene, Leaf. Bot. Obs. 2: 42. 1910.—“Near Tehuacan, Puebla, Mexico, 7 Aug. 1897, *Pringle* no. 6678 as in my set of that collector’s plants.”—Holotypus, ND! isotypi, MO, NY, POM, US!—*Hamosa subuniflora* (Greene) Rydb. in Bull. Torr. Club 54: 328. 1927.

Hamosa davisiana (of the Davis Mountains) Rydb. in Bull. Torr. Club 54: 328. 1927 (“*Davisiana*”).—“The type was collected in the Davis Mountains, Texas, April 28, 1902, *Earle* & *Tracy* 329 . . .”—Holotypus, NY! isotypi, GH, ND, US!—*Astragalus davisianus* Greene ex Rydb., l. c., in syn.

The var. *austrinus* is the common small-flowered milk-vetch in Texas westward from the Edwards Plateau, in New Mexico southward from Albuquerque and Santa Rosa, and in southeastern Arizona, whence it extends southward, apparently somewhat interruptedly, into central and southern Mexico. Intergradation with var. *trichocarpus* eastward, and with var. *micranthiformis* in central Arizona and the upper Rio Grande valley, has already been mentioned. Westward from central Arizona, where it is found in typical form together with var. *imperfectus*, there is also a zone of intergradation with these two forms; and it apparently passes into var. *cedrosensis* also in northern Sonora. Over the great part of its range var. *austrinus* is similar in most respects to var. *trichocarpus*, although usually of more delicate mien and with only 3–5 pairs of narrowly elliptic leaflets in most mature leaves. It varies in habit of growth according to the season and the type of soil. In dry springs, in sandy soils, and in desert climates, the commonly ascending stems and peduncles tend to become subfiliform and the flowers exceptionally short and pale in coloring; plants rooting in hard-packed or well-watered soils at greater elevations are likely to be prostrate and stouter-stemmed. Ordinarily appressed, the gray or silvery vesture of the leaves and stems is sometimes looser, and a densely silvery-hirsutulous form, not uncommon in trans-Pecos Texas where it is associated with and passes into a more normal type of plant, has been described as *Hamosa davisiana* but deserves no more than passing mention. Some young plants of var. *austrinus* (as of other varieties of the species) assume a peculiar aspect when all the peduncles are subfiliform and bear only one or two terminal flowers; the typus of *A. subuniflorus* was of this nature. The apparent isolation of the latter in Puebla, so far south of the known continuous range of var. *austrinus*, suggests the probability of a distinct form; but not only *Pringle*’s but subsequent collections from the same general area can be matched closely by material from southern Arizona and New Mexico (cf. *Peebles* 11,334, POM). Possibly var. *austrinus* is introduced in Puebla, although three collections made over a period of years argue its naturalization there. I have interpreted two collections from the Gulf Coastal Plain in southern Texas as probably adventive also.

Unlike the eastern Texan varieties of *A. Nuttallianus* described up to this point, in which the pod is consistently either glabrous or pubescent, both states occur with about equal frequency in var. *austrinus*. A feature easily observed and very often significant in the genus,

the presence or absence of hairs on the fruit has captured the attention of botanists and has been overemphasized as a differential character. Although it is most uncommon to find glabrous and strigulose pods in one colony of plants in the field (they are more often mixed in herbaria), small colonies of both sorts are frequently found scattered here and there within a plot of a few acres. The members of these nearly sympatric colonies often resemble one another precisely in other characters which are variable in the variety as a whole. Bearing in mind that var. *imperfectus* and var. *micranthiformis* vary in the same manner, yet in their discrete ranges peripheral to that of the complex are even more clearly monophyletic, I must regard the pubescence-variants of var. *austrinus* likewise as insignificant formae.

The var. *austrinus*, first encountered during the pioneer explorations of August Fendler and Charles Wright in the middle of the last century, has become to western botanists the best-known form of *A. Nuttallianus*. Gray at first tried to sort out the minor variants, but gave up the attempt as early as his revision (1864, p. 199) wherein all are included in a comprehensive and polymorphic species. As material of var. *austrinus* accumulated in herbaria under the name of *A. Nuttallianus*, the circumscription and identity of the original species were forgotten, and by a shift of emphasis the present variety became for Jones (1898, p. 22; 1923, p. 269) the typical and our var. *Nuttallianus* a subordinate variety (vars. *enneajugus* and *quadrilateralis*). This error was corrected by Rydberg (1927, p. 325), who had more direct access to pertinent type-material. Rydberg, however, not only interpreted the glabrous and pubescent fruiting phases of var. *austrinus* as separate species of *Hamosa*, but included in the pubescent *H. austrina* elements of our var. *trichocarpus* and in the glabrous *H. Emoryana* an important, in fact lectotypical element of a distinct species, *A. Emoryanus* of this account. The latter, which is sometimes associated with the glabrous-fruited mutant of var. *austrinus*, is quickly separated by its retuse leaflets, blunt keel-tip, and early deciduous pod.

For nomenclatural purposes I have ignored *A. Nuttallianus* var. *canescens* T. & G. ex Wats., although it was clearly based in part on the present variety and could possibly be revived for it. Its history is rather curious. As a valid proposition it dates back no further than to Watson's Bibliographical Index, where it is simply listed with references to T & G. in Pac. R. R. Rep. 2: 163 and to Parry in Amer. Nat. 9: 270: Watson mentioned as synonymous some unnamed varieties of *A. Nuttallianus* described by Gray in *Plantae Wrightianae* (1: 52 & 2: 43). The Parry reference is irrelevant as it involves no description and is concerned with a collection of var. *imperfectus* from southern Utah. Turning to the *Railroad Report*, we find again simply listed by Torrey & Gray an "*A. Nuttallianus* DC. var. *trichocarpus* & *canescens*, Gray, Pl. Wright . . ."; it is clear that we have to go further back for a validating description. In the first volume of *Plantae Wrightianae*, Gray listed a collection of Wright's from New Mexico (in 1851) with a Latin phrase describing a dwarf, canescent plant with rather short pods similar to those of var. *trichocarpus* but glabrous; and he remarked that Fendler's No. 156 was nearly the same. Unquestionably this constituted the first description of var. *austrinus*, although Gray made no formal proposition. In the second volume dealing with Wright's plants (1853) no less than three forms of *A. Nuttallianus* were distinguished, again without names but with descriptive phrases, from among three sets of numbered specimens (*Wright 1001, 1359, 1360*) involving collections from at least seven localities in western Texas, New Mexico, and northern Chihuahua. Whether these collections were kept separate by Wright and afterward renumbered and distributed without data or with inexact data by Gray (a common practice at the time) they are now hopelessly muddled. The material extant under these Wright numbers in the Gray and Torrey herbaria includes elements of *A. austrinus* with glabrous and with pubescent fruit, and a good sprinkling of *A. Emoryanus* which has only recently been appreciated as a distinct species. The first form mentioned by Gray in *Plantae Wrightianae* Vol. 2 is based on a mixture of *A. Emoryanus* (its holotypus) and pubescent var. *austrinus*. The second is supposedly the same as the var. first mentioned in Pl. Wright. Vol. 1, but the description now calls for a cinereous-hispidulous (not glabrous) pod; it is evidently wholly var. *austrinus*, as is the third, a very tiny form with diffuse stems and short pods from Lago Santa Maria in Chihuahua, characteristic of plants growing in the stiff soil of a desert playa. Since var. *canescens* T. & G. was never really proposed by Torrey and Gray, and at best is based on descriptions of two species not distinguished correctly even at the level of unnamed forma, it seems wise to discard it as a confused name.

333g. *ASTRAGALUS NUTTALLIANUS* var. *IMPERFECTUS*

Always slender, the prostrate or weakly ascending (when solitary, erect) stems 2–30 (45) cm. long, the herbage strigulose with rather stiff, straight, appressed or ascending, lustrous hairs up to 0.55–0.9 (1) mm. long, the leaflets greenish-cinereous or canescent, pubescent on both sides but sometimes thinly so above; leaves 1.5–4.5 (5.5) cm. long, with 7–11 (13) broadly to narrowly

elliptic or oval leaflets 2–10 mm. long, all acute, subacute, or rounded at apex, those of the lower leaves sometimes broadest; *peduncles* (1) 2–7 (8) cm. long, mostly longer (or some early, 1-flowered ones shorter) than the leaf; *racemes* 1–4-flowered, the axis (0) 2–10 mm. long in fruit; *calyx* 3.2–4.5 mm. long, strigulose or hirsutulous with appressed or narrowly ascending, white or black and white hairs up to (0.35) 0.5–0.8 mm. long, the tube 1.9–2.8 mm. long, 1.1–1.8 mm. in diameter, the lance-subulate teeth 1–1.7 (2) mm. long; *petals* whitish or faintly lilac-tinged; *banner* 4.1–6.5 (7.3) mm. long, 2.2–4.5 (4.8) mm. wide; *wings* 3.8–5.6 (6.2) mm. long; *keel* 4.1–5.4 (5.9) mm., the claws 1.9–2.4 (2.8) mm., the blades obliquely triangular or lunately half-elliptic, (2.2) 2.6–3.4 mm. long; *pod* as in var. *austrinus* externally, (1) 1.2–2.1 cm. long, 1.9–3.1 mm. in diameter, gently incurved at or near the base and often straight or nearly so distally, the valves glabrous or strigulose with hairs up to 0.25–0.5 (0.6) mm. long, the septum varying from complete and up to 1.5 mm. wide to a rudimentary wing in the lower half of the pod; *ovules* 12–16.—Collections: 53 (vii); representative: *Clokey 8712* (CAS, NA, NY, OB, SMU, TEX, WIS, WS, pod pubescent, septum subobsolete), *8716* (CAS, NY, WS, pod pubescent, septum complete); *Ripley & Barneby 3338* (CAS, RSA, pod glabrous, septum subobsolete); *Wiegand & Upton 3615* (NY, pod glabrous, septum broad).

Open sandy or gravelly flats, hillsides, and washes, about 900–5200 (in Death Valley up to 6400) feet, with *Larrea*, sahuaro, and (northward) Joshua-tree, on granite and limestone, locally abundant over the deserts drained by the lower Colorado and Gila Rivers, eastern Mohave Desert, California to southwestern Utah (Washington County, in the Virgin Valley), southeast to Pima County and Sonoita Valley in Santa Cruz County, Arizona, west in California to the Little San Bernardino Mountains; apparently in the Cucupa Mountains, northeastern Baja California; collected once (possibly adventive) in Great Salt Lake (Antelope Island), northern Utah.—Map No. 150.—March to June.

ASTRAGALUS NUTTALLIANUS var. IMPERFECTUS (Rydb.) Barneby in Leaf. West. Bot. 3: 109. 1942, based on *Hamosa imperfecta* (incomplete, of the septum) Rydb. in Bull. Torr. Club 54: 329. 1927—"NEVADA: Rhyolite, Nye County, May 17, 1909, Heller 9637..."—Holotypus, NY!

The var. *imperfectus* is very closely related to var. *austrinus* from which, as we have seen, it is not clearly differentiated in central Arizona. Northward and westward, however, it may be recognized by its deeply campanulate calyx with comparatively short teeth which lack the long, stiff, shining trichomes so characteristic of vars. *austrinus* and *trichocarpus*. As in var. *austrinus* the pod varies from one colony to the next in being glabrous or strigulose; the latter is the much commoner of the two states, whether the septum be present or lacking within. The variety was originally drawn to include, as was *Hamosa imperfecta*, only those forms with unilocular pods. In reality the legume is never fully unilocular, for although the septum may be truly obsolete in the upper two thirds, at least a rudiment persists in the incurved lowest third or quarter. The subunilocular phase of var. *imperfectus* is about equally common and has almost the same range as the bilocular one in Utah, Nevada, and California, but it seems to be absent in Arizona southward from Mohave County. Externally the pods of the two phases are identical, as are all other details of the plants, and the nomenclaturally typical, "imperfect" phase is here considered a minor variant. The variety seems to be morphologically confluent with var. *cedrosensis* southward. There is one collection of doubtful identity, with the calyx of var. *imperfectus* and some emarginate leaflets in the lower leaves quite suggestive of var. *cedrosensis*, from as far north as the Panamint Mountains (*Coville & Funston 513*, NY). The record from Salt Lake was made by Sereno Watson on King's Exploration and has not been confirmed, to my knowledge, in latter years. The plant was very likely introduced, possibly by livestock from the Mormon settlements on the Virgin River in southwestern Utah.

333h. ASTRAGALUS NUTTALLIANUS var. CEDROSENSIS

Habit of var. *imperfectus*, the stems usually very slender or filiform, the herbage strigulose, the leaflets thinly pubescent above; *leaves* mostly 1.5–4.5 cm. long,

with (5) 7–11 leaflets, those of the lower leaves cuneate-retuse or -emarginate, or obcordate, 1–5 mm. long, those of the upper leaves linear-elliptic, acute, and up to twice longer; *peduncles* almost capillary, (0.8) 1.5–8.5 cm. long; *racemes* 1–3-flowered, the axis 0–2 cm. long; *calyx* about (1.7) 2.5–3 mm. long, the tube (1) 1.4–1.7 mm. long and about as broad, the teeth (0.7) 1–1.6 mm. long; *petals* whitish or faintly lilac-tinged; *banner* 3.7–6 mm. long; *keel* 3.7–4.5 mm., the claws 1.3–2 mm., the lunately triangular blades 2.5–3 mm. long, its apex subacute; *pod* as in var. *imperfectus*, (0.7) 1–2 cm. long, 1.6–2 mm. in diameter, the valves minutely strigulose, the septum complete or incomplete.—Collections: 15 (i); representative: *Wiggins* 5243 (CAS, NY), 6261 (NY, POM); *Raven, Mathias & Turner* 12,372, 12,562 (CAS); *Ripley & Barneby* 10,008 (RSA); *Brandeggee* 536 (DS, NY).

Desert flats, stony hillsides, and boulder-strewn washes, mostly below 900 feet, commonly with *Larrea*, apparently not very common, Baja California, near the Pacific Coast between 25° 40' and 30° N. and on the Gulf Coast from 29° N. to the lower western edge of the Colorado Desert in San Diego and Imperial Counties, California; also in westcentral Sonora, apparently up to 2300 feet, along the upper Magdalena River.—Map No. 150.—December to April.

ASTRAGALUS NUTTALLIANUS var. *CEDROSENSIS* (of Cedros Island) Jones, Rev. Astrag. 270, Pl. 68. 1923.—“Cedros Island, Lower California, Palmer, No. 692.”—Holotypus, collected March 18–20, 1889, US! isotypi, GH, ND, NY!—*A. cedrosensis* Vasey & Rose in Contrib. U.S. Nat. Herb. 1: 15. 1893, nomen.

Astragalus pertenuis (thin) Greene, Leaf. Bot. Obs. 2: 42. 1910.—“A Lower California species, known to me in flowering specimens from Los Angeles Bay and in fruiting ones from Cedros Island, all collected years ago by Edward Palmer.”—Holotypus (*Palmer* 571 from Los Angeles Bay), collected in November or December, 1887, ND! isotypus, NY! paratypi (*Palmer* 692, from Cedros Island) cited above.—*Hamosa pertenuis* (Greene) Rydb. in Bull. Torr. Club 54: 329. 1927.

The var. *cedrosensis* resembles the most slender phases of either var. *austrinus* or var. *imperfectus* in habit of growth and outline of the pod, and is recognized principally by its dimorphic leaflets. The extreme form has almost threadlike stems and peduncles, small and distant leaflets, and minute, whitish flowers. The shallow calyx-tube recalls that of var. *austrinus*, but the short, comparatively short-hairy teeth and the often imperfectly septate or sub-unilocular pod are more nearly like those of var. *imperfectus*. Ambiguous specimens from Sonora and from the head of Coachella Valley in California bear witness to morphological confluence of the three varieties. I have not seen *Parish* 9656 from the Mohave Desert, cited as *Hamosa pertenuis* by Rydberg (1927, l.c.), which may furnish another example of a few retuse leaflets in var. *imperfectus*, a minor variation mentioned under the preceding.

333i. *ASTRAGALUS NUTTALLIANUS* var. *ZAPATANUS*

Usually very slender, the prostrate, radiating stems up to 3 dm. long and probably longer, hirsutulous with rather stiff, loosely ascending and incurved hairs up to 0.4–0.75 mm. long, the leaflets green or greenish, thinly pubescent to glabrous above; *leaves* 1.5–4.5 (5) cm. long, the (7) 9–17 narrowly cuneate to oblong, oval, or oblong-cuneate, retuse or deeply emarginate leaflets 2–7 (8) mm. long; *peduncles* more or less dimorphic, the early ones (sometimes all) filiform, (2) 5–17 mm. long, 1–2-flowered, the later ones sometimes up to 4.5 cm. long and up to 4-flowered, the racemes subcapitate; *calyx* 3–4.6 mm. long, pilosulous, the tube 1.6–2.7 mm. long, 1.5–2.1 mm. in diameter, the teeth 1.2–1.9 mm. long; *petals* whitish faintly lavender-tinged, or the banner broadly edged with bluish-lilac and striate; *banner* (4) 4.9–6.7 mm. long; *wings* (4) 4.8–6.3 mm. long; *keel* not more than 0.7 mm. shorter than the banner, 3.9–6 mm. long, the claws 1.7–2.4 mm., the obliquely triangular blades 2.3–3.8 mm. long, incurved through 75–90° to the sharply triangular, slightly porrect apex; *pod* 1.3–1.8 cm. long, 2.6–3.2 mm. in diameter, very slightly and evenly incurved, pilosulous with ascending or subappressed hairs up to 0.4–0.5 mm. long, fully bilocular; *ovules*

10-16.—Collections: 7 (ii); representative: *Shinners 17,665* (SMU); *B. L. Turner 4504* (TEX); *LeSueur 215* (TEX); *Ripley & Barneby 9034, 9055* (RSA); *C. & A. Lundell 15,051* (NY).

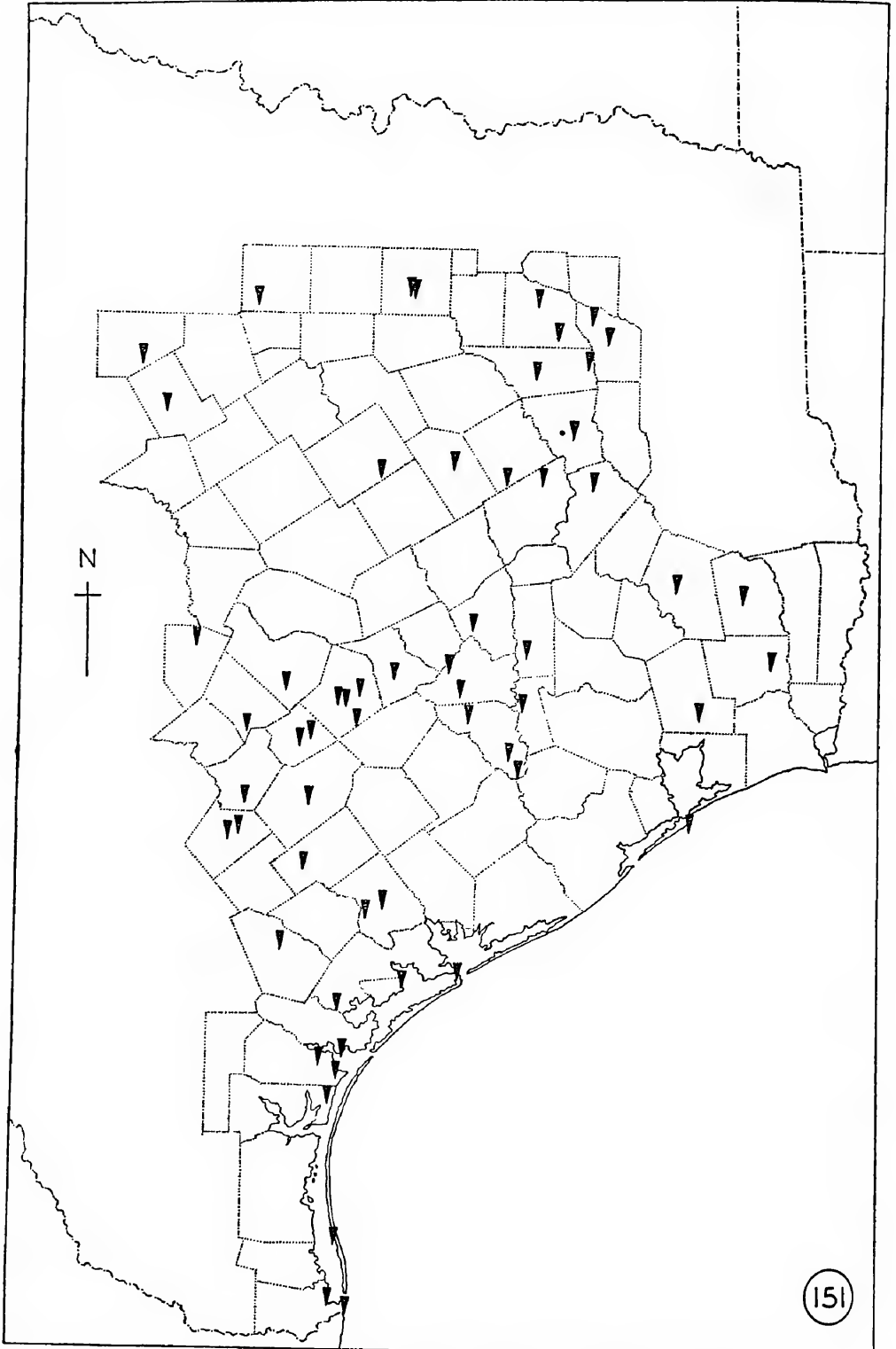
Dry sandy fields, roadsides, and waste places or abandoned gardens, locally abundant in the lower Rio Grande Valley from near Laredo, Texas, southeast to the Gulf Coast in northern Tamaulipas.—Map No. 149.—February and March.

ASTRAGALUS NUTTALLIANUS var. ZAPATANUS (of Zapata County, Texas) Barneby in Field & Lab. 24: 36. 1956.—“... TEXAS. Webb. Co.: Laredo, March 15, 1917, *E. J. Palmer 11289* ...”—Holotypus, NY!

The var. *zapatanus* suggests a delicate, prostrate phase of var. *trichocarpus*, differing in its generally looser vesture of incurved hairs and in the truncate-emarginate leaflets of all, even the uppermost leaves. It forms extensive colonies of homomorphic individuals and is apparently the dominant small-flowered milk-vetch on the sands of Jim Hogg and Zapata Counties, occurring even as a weed in the courthouse square in Hebbronville and along roadsides thereabouts. The early peduncles are short, slender, and mostly 1-flowered; this is a juvenile character, not always perpetuated upward along the stems, the 2-4-flowered, longer-pedunculate, later racemes being hardly different from those of var. *trichocarpus*. While young plants of var. *zapatanus* superficially resemble *A. nyensis*, a piptoloboid annual of southern Nevada, the relationship is not at all close. Truly ripe fruits of var. *zapatanus* are still required to show the manner of fall and dehiscence.

334. ASTRAGALUS LEPTOCARPUS

Precocious annual, with a slender taproot, variable in stature but commonly low and delicate, the stems, leaf-rachises, and peduncles thinly (or when young somewhat densely) strigulose with straight, appressed or subappressed hairs up to 0.3-0.5 mm. long, the leaflets green and glabrous except for a few hairs along the margins and the midrib beneath; *stems* solitary and erect or 2-8 from the root-crown and then ascending, decumbent, or (especially in hard soils) prostrate and radiating, (1.5) 3-20 (30) cm. long, simple except in the most robust plants, often purplish at base; *stipules* submembranous, pale green or purplish, (1) 1.5-5 mm. long, the short lowest ones becoming pallid and fragile in age, the median and upper ones narrowly triangular or lance-acuminate, all about semi-amplexicaul, glabrous dorsally, the margins ciliate and commonly beset with a few knob- or tack-shaped processes; *leaves* 1.5-6 (7) cm. long, the lowest shortly petioled, the rest subsessile, with (7) 11-17 (19) oblong-, obovate-, or oblanceolate-cuneate, retuse or emarginate, or in some lower leaves broadly cuneate-obcordate, flat, rather thick-textured leaflets 2-10 (12) mm. long; *peduncles* erect from erect-ascending and divaricate from procumbent stems, (2) 2.5-9 (10) cm. long, all but some early ones surpassing the leaf; *racemes* loosely but very shortly (1) 2-7 (12)-flowered, the flowers spreading or widely ascending, the axis not or scarcely elongating, 0-12 (20) mm. long in fruit; *bracts* membranous, pallid or purplish, ovate or lanceolate, 0.8-2 mm. long; *pedicels* ascending or a little arched outward in age, at anthesis 0.4-1.1 mm., in fruit somewhat thickened and 0.8-1.7 mm. long, persistent; *bracteoles* 0; *calyx* (3) 3.6-4.5 (5.3) mm. long, strigulose with white or rarely with some or all fuscous or black hairs up to 0.25-0.4 mm. long, the subsymmetric disc 0.5-0.8 mm. deep, the campanulate tube (1.8) 2-2.4 (2.8) mm. long, (1.4) 1.6-2.2 (2.7) mm. in diameter, the rather broadly subulate teeth 1.2-2.2 (2.8) mm. long, the whole becoming papery, marcescent unruptured; *petals* magenta- or amethystine-purple, drying violet, the banner with a large, white, striate eye, the wings often white-spotted distally near the inner margin; *banner* gently recurved through $\pm 40^\circ$, ovate-cuneate or broadly rhombic-elliptic, deeply notched, (5.2) 8.3-12 (13.2) mm. long, (4) 5.2-7.4 (8.4) mm. wide; *wings* (5) 7.2-9.8 (11.3) mm. long, the claws (1) 2-2.5 (2.9) mm., the oblanceolate or narrowly oblong-elliptic,



Map No. 151. Eastern Texas. Range of *A. leptocarpus*.

obtuse but often erose-undulate, slightly incurved blades (5) 5.7–7.5 (8.8) mm. long, 1.4–3 (3.3) mm. wide; *keel* (4.5) 6–7.8 (9) mm. long, the claws (1.2) 2.1–2.8 (3.1) mm., the half-elliptic or obliquely triangular blades (3.4) 3.9–5 (6) mm. long, (1.7) 2–2.4 (2.7) mm. wide, abruptly incurved through 85–95° to the narrowly triangular, acute, porrect, often beaklike apex; *anthers* 0.35–0.45 (0.5) mm. long; *pod* horizontally spreading or ascending at a wide angle, sessile but cuneately tapering at base into a thick, sometimes stipelike neck up to 0.5 mm. long, narrowly linear or linear-oblongate in profile, straight or rarely slightly and evenly incurved, narrowly cuneate and shortly cuspidate at apex, (1.7) 2–3.7 cm. long, 2.2–3.1 (3.5) mm. in diameter, triquetrously compressed with at first nearly flat but ultimately convex lateral and narrower, narrowly sulcate dorsal faces, carinate ventrally by the rather thick, prominent suture, the very slightly fleshy, green or purplish, glabrous valves becoming papery, at first brownish but ultimately almost black, delicately cross-reticulate, inflexed as a complete septum about 1.5–1.8 mm. wide; *dehiscence* apical and downward through the ventral suture, the septum also splitting in age, and the valves somewhat coiled distally; *ovules* (17) 20–26; *seeds* subquadrate, pale brown sometimes speckled with purple, smooth but scarcely lustrous, 1.7–2.2 mm. long.—Collections: 70 (i); representative: *Tracy 9104* (NY, SMU, TEX, WIS), *9111* (NY, TEX); *Shinners 9807, 9920* (OKLA, SMU), *11,030* (SMU, TEX); *Cory 55,397* (SMU, WS); *Reverchon 241* (NY, SMU); *F. H. Wagner 21* (NY, SMU).

Open post oak woodlands, mesquite thickets, sandy fallow fields and roadsides, mostly in light porous soils, 5–1000 feet, locally plentiful on the Gulf Coastal Plain in eastern Texas, from the mouth of the Rio Grande to the lower Neches River and the Balcones Escarpment, north, becoming less frequent, on calcareous prairies to Dallas and Eastland Counties; one old record from "Arkansas" requires confirmation.—Map No. 151.—March to May.

ASTRAGALUS LEPTOCARPUS (with slender pod) T. & G., Fl. N. Amer. 1: 334. 1838.—"Near the Sabine River, Dr. Leavenworth! Texas, Drummond!"—Cotypi, labeled: "Arkansas, Leavenworth," and "Texas, Drummond Coll. I," NY! isotypi (*Drummond*), BM, G, GH, OXF, P!—*Tragacantha leptocarpa* (T. & G.) O. Kze., Rev. Gen. 946. 1891. *Hamosa leptocarpa* (T. & G.) Rydb. ap. Small, Fl. SE. U. S. 617, 1332. 1903.

Astragalus Nuttallianus var. *leptocarpoides* (resembling *A. leptocarpus*) Jones, Contrib. West. Bot. 8: 22. 1898.—"Galveston Is., Texas, on dry prairies, May 1, 1843, Lindheimer, Mo. Bot. Gard. Nos. 17070, 17071."—Holotypus (2 sheets), MO! istoypus, GH!—*Hamosa leptocarpoides* (Jones) Rydb. in Bull. Torr. Club 54: 326. 1927. *Astragalus leptocarpoides* (Jones) Cory in Rhodora 38: 406. 1936.

The bodkin milk-vetch, *A. leptocarpus*, is a pretty little species with small, brightly colored flowers, sometimes faintly, yet agreeably fragrant. It is closely related to *A. Nuttallianus* and might logically be treated as forming part of that polymorphic complex; for apart from the ordinarily longer pod enclosing from one to four extra pairs of ovules and seeds, it possesses no single attribute which cannot be matched somewhere in *A. Nuttallianus*. In practice it is easily distinguished from sympatric varieties of *A. Nuttallianus*: from var. *trichocarpus* by its glabrous ovary; from var. *pleianthus* by its retuse leaflets; from var. *macilentus* by the acute keel-tip; and from var. *Nuttallianus*, which it most nearly resembles in its green, glabrescent foliage and in shape of the leaflets, by the nearly always longer and more amply proportioned flower. However a rare form occurs, sometimes associated with normal plants, in which the flowers are quite small, with calyx scarcely over 3 mm. and banner 5.2–6 mm. long (and other petals proportionately shortened), as noted in parentheses in the description. Individual specimens of this sort might be confused with var. *Nuttallianus* but still differ in their shorter calyx-teeth, in ovule-number, and ultimately in the long, commonly straight pod. Like occasional "gigas" individuals with abnormally large flowers, they are interpreted as sporadic and taxonomically unimportant variants. In other respects *A. leptocarpus* varies little. The pod is traditionally described as straight, but is quite often slightly and evenly arched through the whole length (but not more abruptly so at base than distally), and the stems vary from erect to prostrate, as do those of most annual astragali. The typus of var. *leptocarpoides* is

only unusual in so far as a curved pod and prostrate stems are combined in the same plant with relatively small flowers. It has the 20–22 ovules of *A. leptocarpus*. The species was collected first by Berlandier (No. 1431, G), between Bexar and Austin, in 1832.

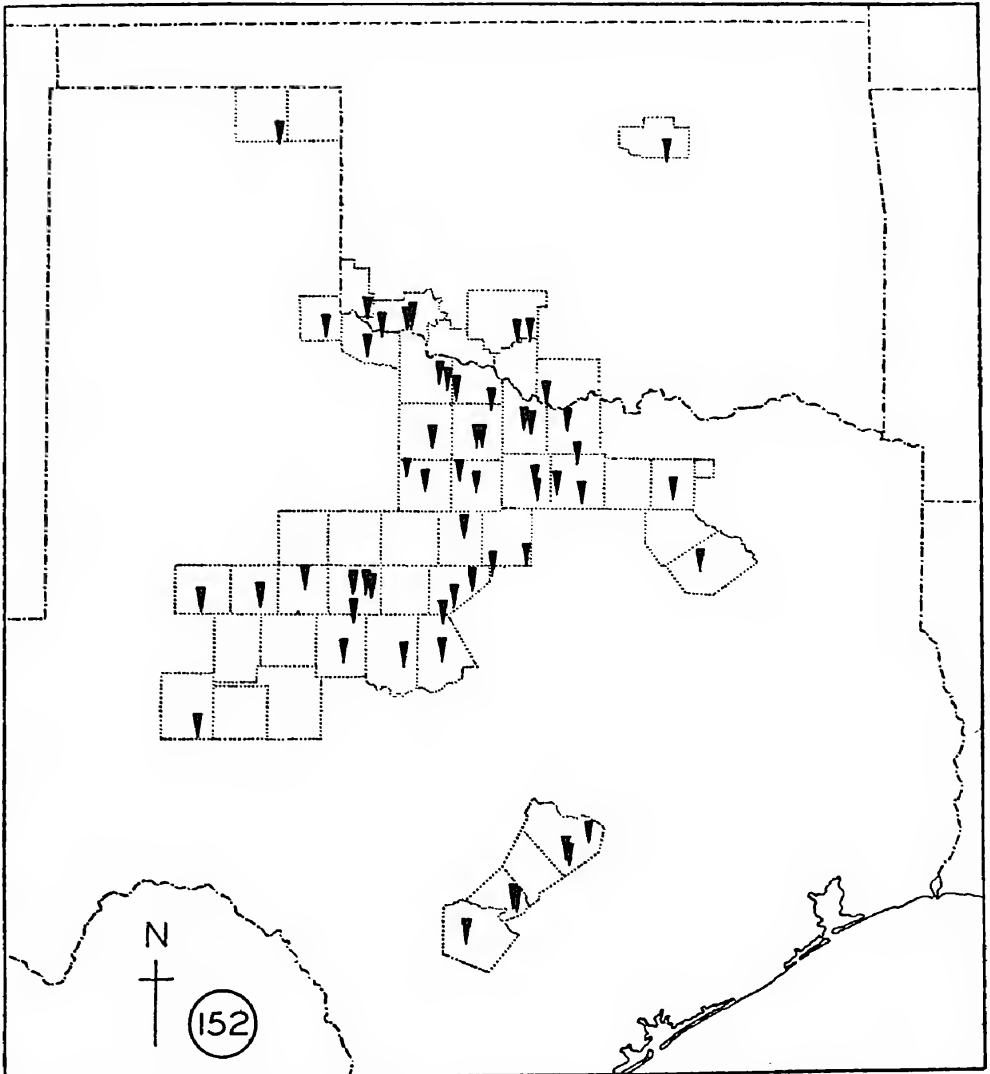
335. *ASTRAGALUS LINDHEIMERI*

Annuals, resembling forms of *A. Nuttallianus* but often coarser, with a slender taproot, thinly strigulose with straight, appressed or subappressed hairs up to 0.35–0.5 mm. long, the herbage green, the leaflets glabrous above; *stems* 1–20 from the root-crown but commonly less than 10, erect when solitary but mostly incurved-ascending or nearly prostrate, (0.2) 0.5–3 (3.5) dm. long, green or purplish, often striate, simple or spurred at 1–3 nodes preceding the first peduncle, floriferous upward from near or below the middle; *stipules* herbaceous or membranous-margined, becoming papery, triangular or triangular-acuminate, 1.5–5 mm. long, about semiamplexicaul; *leaves* (1) 2–6.5 cm. long, petioled but the uppermost quite shortly so, with (11) 13–21 broadly to narrowly cuneate, cuneate-oblong, or -oblanceolate, truncate-emarginate to deeply retuse, flat or loosely folded leaflets of rather thick texture and 2–14 mm. long; *peduncles* ascending or incurved, (1) 2–6.5 cm. long; *racemes* loosely but very shortly (1) 2–6 (8)-flowered, the flowers spreading, the axis scarcely elongating, 0.2–1.5 (2.4) cm. long in fruit; *bracts* submembranous becoming papery and pallid, ovate-acuminate, lanceolate, or linear-caudate, 1.3–5 mm. long; *pedicels* at anthesis slender, ascending, (1) 1.3–2.3 mm. long, in fruit thickened, arched outward, 1.8–3 mm. long, persistent; *bracteoles* usually present as minute scales at or below the base of the calyx; *calyx* (4) 5–8 mm. long, thinly strigulose with white hairs but the teeth glabrous or nearly so externally, the subsymmetric disc 0.5–0.9 (1) mm. deep, the campanulate, often purplish tube (2) 2.4–3.3 mm. long, 2.4–3.6 mm. in diameter, the erect or spreading, narrowly lance-subulate teeth (2) 2.3–5 mm. long, the whole becoming papery, marcescent unruptured; *petals* bicolored, the banner purple-margined around the prominent white but purple-veined eye, the wings white, the keel-tip purple-maculate, the purple turning violet on drying; *banner* recurved through about 35°, broadly ovate or ovate-oblong beyond the shortly cuneate claw, sometimes subflabellate, shallowly notched, (12) 13–18.5 mm. long, 7.2–15.5 mm. wide; *wings* 11.2–17 mm. long, the claws 2.6–4 mm., the broadly oblanceolate or obliquely obovate, nearly straight blades 9.8–14.2 mm. long, (3) 3.5–5.8 mm. wide; *keel* 9.5–12.9 mm. long, the claws 3.4–4.6 mm., the broadly triangular blades (7) 7.5–9.5 mm. long, 3.8–5 mm. wide, abruptly incurved through 90–95° to the obtusely deltoid apex; *anthers* 0.4–0.65 mm. long; *style* minutely barbellate all around just below the stigma, rarely puberulent its whole length; *pod* stipitate, the stout stipe (0.8) 1–2.6 (3) mm. long, ascending at a wide angle, horizontal, or a little declined in line with the pedicel, the linear-oblong or -oblanceolate body gently and lunately or more abruptly and subbasally incurved through about a right angle (the distal half then narrowly ascending and becoming perpendicular in a plane parallel to the raceme-axis), 1.7–2.7 cm. long, 3.5–6 (6.5) mm. in diameter, broadly cuneate or acuminate tapering at base, cuspidate at apex, compressed-triquetrous with flat or low-convex lateral faces and narrower, narrowly sulcate dorsal face, carinate ventrally by the prominent, thick suture, the thinly fleshy, green, glabrous valves becoming thinly leathery or stiffly papery, brownish or when ripe nearly black, inflexed as a complete septum 2.2–3.3 mm. wide; *dehiscence* apical and tardily through the ventral suture; *ovules* 8–12 (14); *seeds* pale greenish- or yellowish-brown, sometimes purple-speckled, smooth, 3.2–4 mm. long.—Collections: 63 (iii) representative: *Shinners* 9964 (OKLA, SMU); *Reverchon* distrib. *Curtiss* 601* (NY, SMU);

McBryde 1006 (NY, TEX); *D. McLean 167* (CAS, TEX); *Ripley & Barneby 7489* (CAS, GH, RSA).

Low hills, barrens, prairies, and gullied bluffs, sometimes abundant in disturbed soil along highways, in dry calcareous gravels, sands, red clay, or gypsum, mostly below 2100 feet, locally plentiful in northcentral Texas and the valley of the Red River in southwestern Oklahoma, in Texas east to Dallas and Navarro Counties and west to Irion and Howard Counties, also apparently isolated on the Balcones Escarpment between San Antonio and Austin; isolated records from the north end of the Texas Panhandle (Ochiltree County) and northcentral Oklahoma (near Stillwater, Payne County) are probably adventitious; a record from Monterrey, Mexico (Jones, 1923, p. 268) has not been traced to the source.—Map No. 152.—Late March to early June.

ASTRAGALUS LINDHEIMERI (Ferdinand Lindheimer, 1801–1879) Engelm. ex Gray, Pl. Wright. 1: 52. 1852.—“Sand bar in the Colorado near Austin, Texas; April. (on rich Muskit soil near water, April, 1850, Lindheimer).”—Lectotypus, *Lindheimer 746*, collected at “Santa



Map No. 152. Oklahoma and parts of Texas. Range of *A. Lindheimeri*.

Clara 10 miles s. of New Braunfels, April, 1850," MO! isotypi, mostly labeled "Comanche Spring near New Braunfels" GH (2 sheets, not annotated by Gray + 1 sheet, renumbered 258 and named in Gray's hand), K, MO, NY, PH, SMU, TEX, US! The paratypus at GH with penciled label "found on sand-bar of the Colorado near Austin, Wright" = *A. Nuttallianus* var. *macilentus*.—*Tragacantha Lindheimeri* (Engelm.) O. Kze., Rev. Gen. 946. 1891. *Hamosa Lindheimeri* (Engelm.) Rydb. ap. Small, Fl. S. E. U. S. 1332. 1903.

Astragalus Lindheimeri var. *bellus* (pretty) Shinnery in Field & Lab. 25: 33. 1957.—"3.2 miles west of Archer City, Archer Co., Shinnery 18,568, 24 April, 1954..."—Holotypus, SMU!

The Lindheimer milk-vetch is the showiest by far of the annual astragali of Texas, easily distinguished (almost always) from the other *Leptocarpi* by flower-size alone. There is a small overlap in length of banner between *A. Lindheimeri* and the largest-flowered populations of *A. Nuttallianus* var. *macilentus* and *A. leptocarpus*, although the keel is always shorter in both species. At anthesis *A. leptocarpus* differs further in its triangular keel-tip and many (at least 17) ovules, and var. *macilentus* by its more numerous flowers; moreover the style in both is glabrous and the fruit (as in all forms of *A. Nuttallianus*) is of narrower outline and sessile or nearly so. The only other American *Astragalus* beside *A. Lindheimeri* in which a puberulent style has been observed is *A. brazoensis*, by coincidence also a Texan annual, but readily recognized by its many and much smaller flowers and its almost circular, dorsiventrally compressed pod deciduous from a stipelike gynophore.

The flower of *A. Lindheimeri* is uncommonly pretty, because of the contrasts between the large, white eye and the band of lively purple (variable in width) around the margin of the banner, and the white-spotted or white-tipped wings against the broad, purple keel. The range of the species is apparently bicentric, with a large area in northcentral Texas and southwestern Oklahoma and a smaller disjunct one along the Balcones Escarpment between the Colorado River and San Antonio. According to Shinnery the flower in the southern area is smaller and paler (only 11–15 mm. as opposed to 13–18 mm. long) and is combined with shorter peduncles and leafier stems; he has accordingly segregated the northern populations as var. *bellus*, the typus of *A. Lindheimeri* having originated in the southern area. I have not had opportunities of re-examining a large series of specimens since the publication of var. *bellus*, and have not seen fresh material from near Austin, so I feel at a disadvantage in trying to evaluate the supposed differences. Certainly these are far from absolute (and are not even claimed to be so), witness *Reverchon 601* (NY) from Brown County, Texas, with banner 12–13 mm. long, as compared with Thurber's collection from San Antonio (in 1853, NY) in which the banner is 12–14 mm. long and even after a century still brightly colored distally. Possibly Shinnery had partly in mind as var. *Lindheimeri* the large-flowered phase of var. *macilentus*, in which the keel is prominent and the general proportions of the pale flower are very suggestive of *A. Lindheimeri*. Plants of this sort differ, however, in their looser, many-flowered racemes, narrow, subsessile pods, many ovules, and glabrous styles. Considering the relatively large size of the pod, the paucity of ovules is a remarkable feature of the Lindheimer milk-vetch, but the large seeds are of a size to fit the fruit. An albino form has been found rarely in the Red River Valley.

Typification of *A. Lindheimeri* has proved unexpectedly difficult. The material (GH) annotated in Gray's hand is a mixture of the genuine *A. Lindheimeri* as known to Engelm., acknowledged author of the name, and the large-flowered phase of *A. Nuttallianus* var. *macilentus*, represented by Wright's plant from the Colorado River at Austin. There is a specimen of true *A. Lindheimeri* collected by Wright at GH and NY, but both lack Gray's autograph and are apparently irrelevant to our problem. The sheets of *Lindheimer 746* at GH were probably distributed after publication of *Plantae Wrightianae*, for they also lack annotations. Gray's material from Lindheimer consists of two sheets numbered 258 (1850) and 542 (April, 1851). I take them to be duplicates of what Engelm. later sent out under the serial Nos. 746 and 747, respectively. The best choice of holotypus seems to be the sheet in the Engelm. herbarium that bears Lindheimer's own note about the locality, slightly different, it should be noted, from that given on the printed label distributed afterwards. Blankinship (in Rep. Mo. Bot. Gard. 18: 165. 1907) reached a similar conclusion.

LXXX. Sectio SUCCUMBENTES

Perennial, with a long taproot and shallowly buried root-crown; *vesture* basifixed, hirsute; *stipules* free; *leaves* imparipinnate, with 7–17 petiolulate leaflets; *flowers* rather shortly and densely racemose, spreading-ascending, large, the banner about 14–20 mm. long; *pedicels* persistent; *calyx-tube* cylindro-campanulate; *petals* bicolored, irregularly graduated, the banner and keel pink-purple, the wings

about 1–4 mm. longer than the banner, openly notched at apex, whitish; *pod* ascending or erect, sessile, readily deciduous, lunately linear-lanceolate or -oblong in profile, compressed-triquetrous, fully bilocular, the glabrous valves becoming papery; *dehiscence* apical, after falling, ultimately through the length of the ventral suture, the septum-walls also tardily separating; *ovules* 27–38.—Sp. 1, xerophyte, of sandy grounds along the Columbia River in transmontane Washington and northern Oregon.

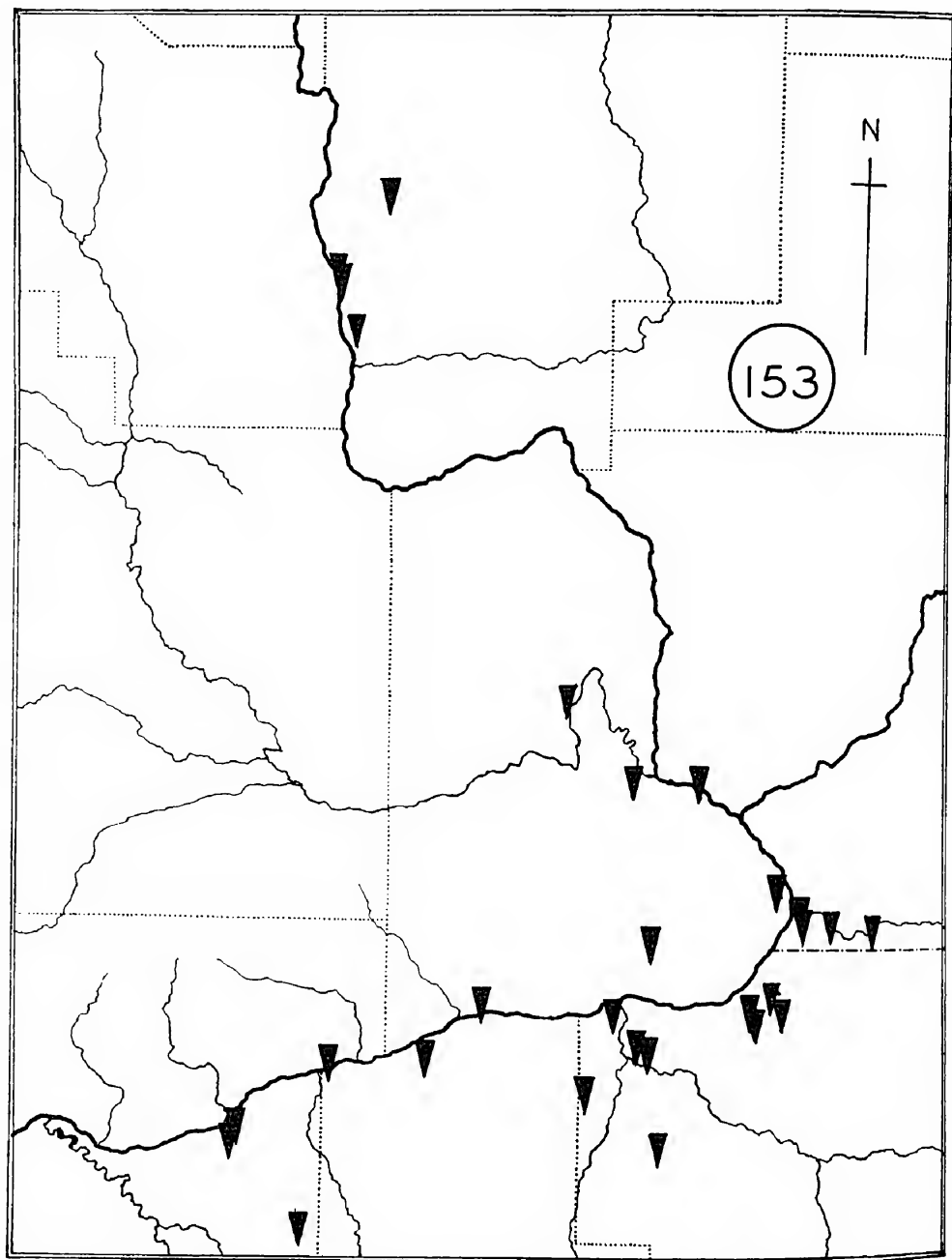
ASTRAGALUS sect. SUCCUMBENTES Gray in Proc. Amer. Acad. 6: 200. 1864.—Sp. unica: *A. succumbens* Dougl.—*Astragalus* sect. *Succumbens* Sheld. in Minn. Bot. Stud. 1: 159. 1894. *Hamosa* sect. *Succumbentes* (Gray) Rydb. in Bull. Torr. Club 54: 13. 1927.

The single species of the present section is taxonomically isolated. The deciduous, compressed-triquetrous, fully bilocular pod is suggestive of a distant relationship with the large sect. *Leptocarpi*, but the curiously proportioned flowers are truly unique. Jones (1923, p. 299) referred *A. succumbens* to his heterogeneous sect. *Malaci*, of which the typus, *A. malacus*, has a pod of similar shape but contracted at base into a short stipe and persistent on the receptacle. I can see no close affinity in this direction. The habitat of *A. succumbens* is dry, hot, and windy, similar in many respects to the environment encountered in the southern deserts where *Astragali* of the hamosoid type are most highly developed and abundant. I suspect that its history goes back to a xerothermic period when paths of migration may have been open between the Columbia Basin and regions to the south.

336. ASTRAGALUS SUCCUMBENS

Low but robust, densely to rather thinly hirsute or hirsutulous nearly throughout with rather stiff, spreading and ascending or somewhat retrorse hairs up to 0.7–1.3 mm. long, the herbage greenish or canescent, the leaflets bicolored, brighter green and sometimes glabrous or medially glabrescent above; *stems* several, (1) 1.5–4 dm. long, arising together from the root-crown shortly below soil-level, the inner ones erect, the outer longer and ascending, together forming flat-topped, bushy plants, all usually divaricately branched or spurred at several nodes preceding the first peduncle, zigzag distally; *stipules* herbaceous or the lowest becoming papery, (1.5) 2.5–8 (9) mm. long, broadly ovate-acuminate, ovate, or lance-acuminate, the lowest (sometimes all) amplexicaul-decurrent around half to nearly the whole stem's circumference, free (exceptionally very obscurely united), the upper ones narrower, usually deflexed; *leaves* 3–8 cm. long, very shortly petioled, divaricate or ascending, with (7) 9–17 obovate or elliptic, acute, obtuse and mucronulate, or rarely retuse, mostly flat leaflets (3) 5–19 mm. long; *peduncles* erect, 1.5–5.5 cm. long, nearly always shorter than the leaf; *racemes* rather densely 10–25-flowered, the axis slightly elongating, (1) 2–5 cm. long in fruit; *bracts* herbaceous, lanceolate or linear-lanceolate, (2.5) 4–12 mm. long; *pedicels* ascending, straight, at anthesis 0.5–1.2 mm., in fruit a trifle or not thickened, 0.9–2.3 mm. long; *bracteoles* 0–2, sometimes conspicuous and up to 4 mm. long; *calyx* 9.5–13 mm. long, very thinly to quite densely hirsute or hirsutulous with white or white and some black hairs, the subsymmetric or strongly oblique disc 1–1.5 (1.7) mm. deep, the membranous, pallid or pinkish tube 7–8.6 mm. long, 3–4.7 mm. in diameter, the subulate or linear-lanceolate teeth 2.5–5.5 mm. long, the whole becoming papery-scarious, ruptured, marcescent; *banner* gently recurved through ± 45 – 50° , broadly oblanceolate to ovate-cuneate, 14–20.3 mm. long, (6.2) 7–10 mm. wide; *wings* (0.3) 1–4 mm. longer than the banner, 17.5–23.7 mm. long, the claws 7–9.4 mm., the oblong-oblanceolate, nearly straight blades 10.5–16 mm. long, shallowly notched or erose on the lower margin just below the more or less obliquely distended apex, 3–5 mm. wide; *keel* shorter than the banner, 12–15.3 mm. long, the claws 7–8.9 mm., the lunately half-elliptic or

-obovate blades 5.3–7.2 mm. long, 2.7–3.8 mm. wide, incurved through 50–95° to the obtusely deltoid or triangular apex; *anthers* 0.6–0.8 mm. long; *pod* ascending or erect, sessile on a minute boss and readily disjuncting when ripe, linear-oblong or -lanceolate in profile, nearly straight to lunately incurved through about $\frac{1}{4}$ circle, (2) 2.5–4 cm. long, (4) 5–7 (8) mm. in diameter, obtuse at base, broadly cuneate to narrowly triangular-acuminate and minutely cuspidate at apex,



Map No. 153. Great Bend of the Columbia River, interior Washington and Oregon. Range of *A. succumbens*.

compressed-triquetrous with sharply carinate ventral and narrow but obtuse lateral angles, the almost flat lateral faces much broader than the narrowly or (at maturity) openly and deeply sulcate dorsal face, the thin, pale green, glabrous valves becoming papery, stramineous, somewhat lustrous, finely cross-reticulate, inflexed as a complete or nearly complete septum 1.2–2.5 mm. wide; seeds buff or olivaceous, often purple-speckled, lustrous but minutely pitted, 1.8–2.9 mm. long.—Collections: 40 (ii); representative: *J. W. Thompson 11,442* (CAS, NY, RM, RSA, WS); *Cronquist 6498* (ID, NY, TEX, WS); *Ripley & Barneby 10,776* (CAS, RSA, WILLU).

Dunes and sandy barrens along the Columbia River and its immediate affluents, 250–1000 feet (reportedly up to 2350 feet in Gilliam County, Oregon), locally plentiful and rather common from Kittitas and Grant Counties, Washington, downstream to Gilliam County, Oregon, apparently most abundant between the mouths of the Yakima and Umatilla Rivers.—Map No. 153.—April to July.

ASTRAGALUS SUCCUMBENS (lying down) Dougl. ex Hook., Fl. Bor.-Amer. 1: 151. 1831.—“On the barren grounds of the Columbia and near the Wallawallah River, North-West America. Douglas.”—Holotypus, from “the junction of Wallahwallah River with the Columbia, 1826.” K! isotypi, BM, GH (fragm.)! the spm. dated 1830 at G is perhaps also an isotypus!—*Tragacantha succumbens* (Dougl.) O. Kze., Rev. Gen. 948. 1891. *Phaca succumbens* (Dougl.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 370. 1906. *Hamosa succumbens* (Dougl.) Rydb. in Bull. Torr. Club 54: 14. 1927.

The crouching milk-vetch, *A. succumbens*, is a plant of strong individuality and of great beauty when in flower. It is easily recognized by its low, rather coarse, distally zigzag stems, copious hirsute vesture, and long, ascending, sessile, compressed-triquetrous pods becoming straw-colored and glossy in the course of ripening. The flowers are remarkable for the exerted, apically dilated and (commonly) notched wings, which are either white or at least much paler than the roseate-purple banner. In relation to the pod's size, the seeds are unexpectedly small.

The identity of *A. dorycnoides*, traditionally listed as a synonym of *A. succumbens*, is discussed in Appendix I.

LXXXI Sectio SCAPOSI

Acaulescent, tufted perennials with superficial root-crown or caudex; vesture dolabriform, dense, ashen or silvery; stipules free; leaflets few, 1–13; flowers few, loosely racemose or subumbellate, small or medium-sized, the banner 9.5–16.5 (21) mm. long; pedicels not thickened, disjointing; calyx-tube campanulate; petals regularly or somewhat irregularly graduated, the wings then a little longer than the banner, the wing-blades dilated and cleft at apex into 2 unequal lobes, the keel-tip obtuse; pod ascending (often but not always humistrate), sessile, deciduous, narrowly oblong, compressed-triquetrous, fully bilocular, the valves papery; dehiscence apical, basal, and through the ventral suture; ovules 13–28.—Sp. 1, xerophyte, composed of several races, widespread in intermontane western United States.

ASTRAGALUS sect. *SCAPOSI* (Rydb.), comb. nov., based on *Hamosa* sect. *Scaposae* Rydb. in Bull. Torr. Club 54: 16. 1927.—Sp. manifeste typica: *H. scaposa* (Gray) Rydb. = *A. calycosus* var. *scaposus* (Gray) Jones.

Astragalus sect. *Hamosi* subsect. *Oxytropidoides* Jones, Rev. Astrag. 254, in clave. 1923.—Sp. lectotypica: *A. calycosus* Torr.

The nearest relatives of the *Scaposi* are presumably the perennial *Leptocarpi* which have similar fruits but diffuse, developed stems. Jones assumed a close affinity with *A. arizonicus*, on account of the dolabriform hair-attachment, but the *Scaposi* differ greatly in the acaulescent growth-habit, cleft wings, and obtuse keel. The pod might be visualized as doubly deciduous, for points of separation develop simultaneously between fruit and receptacle and between the fertile pedicel and the raceme-axis, although calyx, pod, and pedicel commonly fall together, the pod only separating on the ground. After dehiscence, which starts from both ends and

proceeds through the length of the ventral suture, the valves curl back from each extremity to form a cursive x-shaped figure.

The subsection *Oxytropidoides* was so defined by Jones as to include *A. arizonicus* as well as *A. calycosus*, which were said to be closely allied to *Oxytropis* DC. Such resemblances as exist are purely superficial, for neither fruit nor flower agrees in detail with that genus. The acaulescent *A. calycosus* is here designated as lectotypus of the subsection, since its tufted habit of growth and cleft wing-petals are more nearly matched by the type of *Oxytropis* common in western America (and most familiar to Jones). With *A. arizonicus* excluded (it forms subsect. *Arizonici* of the preceding *Leptocarpi*), the *Oxytropidoides* become the precise equivalent of Rydberg's *Scaposae*.

337. ASTRAGALUS CALYCOSUS

Low, sometimes dwarf or even diminutive, tufted, matted, or rarely mounded, essentially acaulescent, perennial, with a slender or at length stout and woody taproot and multicapital root-crown or closely forking caudex, densely strigulose throughout with straight, appressed, contiguous and parallel hairs up to 0.5–0.75 (1) mm. long, the herbage canescent or silvery, the vesture of the upper leaf-surface often turning a greenish-golden color when dried; *stems* 0, rarely up to 2 cm. long, the internodes then nearly always concealed by imbricated stipules; *stipules* 1.5–6 mm. long, submembranous becoming firmly papery, ovate or triangular, commonly obtuse, about semiamplexicaul; *leaves* 1–13 cm. long, with slender or filiform, rarely rather stiff, mostly recurved and subpersistent petioles and 1–13 obovate-cuneate, rhombic-obovate, oblanceolate, or elliptic, obtuse, acute, or exceptionally retuse leaflets 2–19 mm. long, when only 3 (as commonly) palmately trifoliolate, when more numerous usually crowded, the rachis mostly 1 cm. long or less, in one var. up to 4.5 cm. long; *peduncles* scapiform, mostly quite slender, 1–7 cm. long and weakly ascending or arcuately reclining in fruit, occasionally stiffer, erect or ascending even in fruit and up to 25 (30) cm. long; *racemes* loosely but usually shortly 1–8-, more rarely loosely 7–17-flowered, the flowers ascending or spreading, the axis usually less than 3 cm., rarely up to 7 cm. long in fruit; *bracts* scarious or early becoming so, ovate, 0.5–1.7 (2) mm. long; *pedicels* ascending, straight or a trifle arched outward, at anthesis 0.7–1.8 (2.5) mm. long, in fruit not or scarcely thickened, 1.1–3 (3.5) mm. long; *bracteoles* 0, rarely a minute scale; *calyx* 4.7–10.6 mm. long, densely strigulose with white and often some black hairs, the symmetric or decidedly oblique disc 0.7–1.1 mm. deep, the tube 3.7–6.4 (6.7) mm. long, 2.2–4.5 mm. in diameter, the erect or somewhat incurved, subulate or triangular teeth 0.5–3 (4.2) mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish (drying ochroleucous), flesh-color, milky-blue, pink, or bright purple, but the wing-tips always white or pallid and the keel-tip nearly always maculate, the banner (and sometimes other petals) tending to persist about the forming pod; *banner* recurved through $\pm 45^\circ$, rarely 90° , 9.5–16.5 (20.8) mm. long, variable in outline, mostly with cuneate claw abruptly expanded into an ovate, suborbicular, or obreniform blade 6–10 (13) mm. wide; *wings* slightly longer or shorter than the banner, 9–17 (19.7) mm. long, the claws 3.6–6.2 (7.2) mm., the blades (6.3) 7–12 (14) mm. long, through the proximal $\frac{2}{3}$ – $\frac{3}{4}$ narrowly oblong or oblanceolate and 1.1–3.3 mm. wide, straight or slightly incurved, more or less dilated distally and cleft into 2 oblong or ovate, obtuse or subacute lobes (0.7) 1–4.5 mm. long, the lower (exterior) lobe commonly erect, the inner one usually broader and abruptly twisted inward toward the banner, the intervening sinus sometimes minutely appendaged; *keel* 7.4–11.6 (12.7) mm. long, the claws 3.5–6.2 (7.7) mm., the half-obovate or obliquely oblanceolate blades 4–6.7 mm. long, 2.1–3.2 (3.5) mm. wide, abruptly incurved through 85 – 100° to the rounded or bluntly deltoid apex; *anthers* 0.45–0.6 (0.7) mm. long; *pod* ascending (commonly humis-

trate), sessile, oblong-elliptic, linear-oblong, or lance-acuminate in profile, straight or gently lunate-incurred, (0.8) 1–2.1 (2.5) cm. long, (2.5) 3–4.5 mm. in diameter, rounded at base, cuspidate at apex, compressed-triquetrous with acute ventral and narrow but obtuse lateral angles, the plane or low-convex lateral faces broader than the narrowly grooved dorsal one, the thin, cinereously strigulose valves becoming papery, inflexed as a complete or nearly complete septum; *seeds* light or dark brown, sometimes nearly black, lustrous but irregularly pitted, 1.9–2.4 (2.8) mm. long.

The Torrey milk-vetch, *A. calycosus*, is a polymorphic species widely dispersed in the arid interior of western United States and is especially variable in habit of growth. Individual plants may form a diminutive tuft, or a depressed cushion up to 1.5 dm. in diameter, with 2–4-flowered racemes immersed in or barely projected beyond the foliage, but these common dwarf forms pass by gradual transition into a relatively robust, loosely tufted phase, with erect scapes and loose racemes of as many as seventeen flowers, the whole well over 2 dm. tall. The leaflets vary from one to thirteen to the leaf, the calyx from less than 5 mm. to over 10 mm. (with teeth 0.5–4 mm.) long, and the banner from less than 9 mm. to over 16 (very rarely over 20) mm. long. Segregates proposed and maintained on number of leaflets, number of flowers, length of calyx-teeth, or general growth-habit have no just claim to specific rank. The importance attached to length of the calyx-teeth, whether absolute or relative to the tube, has been overestimated. The pod, of the same form throughout the species, sens. lat., varies approximately between one and two centimeters long in each variety, and to nearly the same degree in many colonies of otherwise like plants. With evidence of instability in all the available differential characters, it has become increasingly difficult to define in mutually exclusive or exact terms the geographic varieties, which probably correspond to climactic points on a sliding scale of variation rather than to discrete entities.

Key to the Varieties of *A. calycosus*

1. Leaves 1–6 cm. long, with 1–7 (in var. *mancus* up to 13, but then very small and crowded) leaflets disposed on a rachis 0–1 cm. long; *scapes* weakly ascending or decumbent, 1–7 cm. long; *racemes* 1–6 (8)-flowered, the fruiting axis 2–20 (30) mm. long; Grand Canyon, Arizona, to e. California, centr. Idaho, and s.-w. Wyoming (2)
 2. Leaves (except a few primary ones) 3-several-foliate (3)
 3. Leaflets 3–7, (3) 5–19 mm. long; widespread, mostly at middle elevations 337a. var. *calycosus*
 3. Leaflets 7–13, mostly 2–6 mm. long; high-montane in Nevada and n.-w. Utah 337c. var. *mancus*
 2. Leaves (all or nearly all) reduced to a solitary, terminal leaflet 337b. var. *monophyllidius*
1. Leaves 2.5–13 cm. long, with (5) 7–13 leaflets disposed on a rachis 5–45 mm. long; *scapes* typically erect and ascending, 4–25 (30) cm. long; *racemes* 4–17-flowered, the axis 1–7 cm. long in fruit; s.-e. Nevada and across n. Arizona to n.-w. New Mexico 337d. var. *scaposus*

337a. ASTRAGALUS CALYCOSUS var. CALYCOSUS

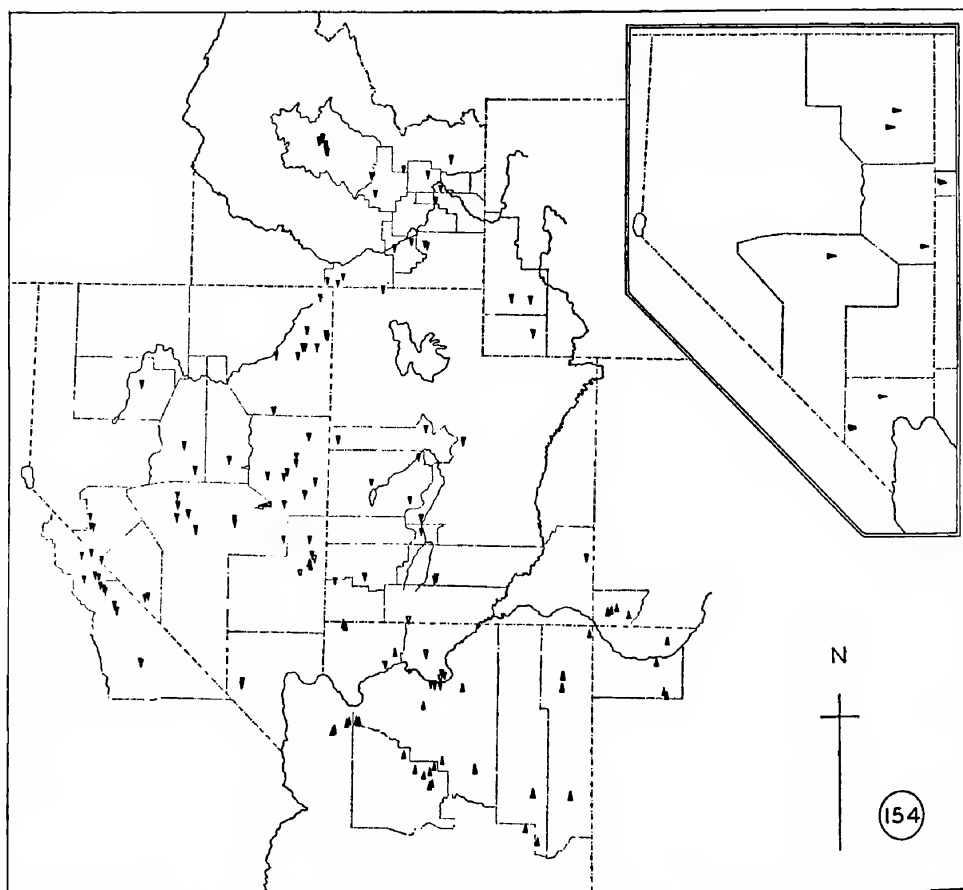
Tufted or mounded, low and dwarf, the leaves 1–7 cm. long, the scapes either shorter than the leaves or, if longer, weakly ascending and reclinate in fruit; *leaves* often palmately trifoliate, but as commonly with 1–2 lateral pairs, the rachis then not over 1 cm. long; *racemes* (1) 2–6 (8)-flowered, the axis 2–20 (25) mm. long in fruit; *calyx* 5.2–10.6 mm. long, the tube 4–6.4 (6.7) mm., the teeth (1) 1.5–4.2 mm. long; *petals* whitish to bright pink-purple, the banner 10–16.5 (20.8) long; *wings* 10.2–17 (19.7) mm. long, the terminal lobes 1.1–4.5 mm. long, the intervening sinus naked or appendaged; *keel* 7.4–11.6 (12.7) mm. long.—Collections: 104 (xvi); representative: *Hitchcock & Muhlick 8996* (CAS, NY, WS, WTU); *J. & C. Christ 17,740* (ID, NY, RSA); *Maguire & Holmgren 25,245, 25,927* (NY, RSA); *M. & G. Ownbey 2869* (CAS, NY, RSA, SMU, WS); *Clokey 8002* (CAS, NA, NY, OB, RSA, SMU, TEX, WIS, WS, WTU); *Ripley & Barneby 4377* (RSA), *10,634* (CAS, RSA); *Duran 3285* (CAS, NY,

OB, WIS, WS); *Wiggins & Rollins* 563 (CAS); *Eastwood & Howell* 968 (CAS).

Dry open hillsides, knolls and ridges, in sandy or gravelly clay soils commonly derived from limestone, but also on granite, shale, sandstone, and probably other formations, in Idaho sometimes in volcanic sand, with piñon, juniper, and sagebrush, mostly 4200–8500, rarely (in Nevada) up to 11,300 feet, widespread and locally plentiful from Death Valley northwest along the east slope of Owens Valley to Mono Lake, California, northeast across Nevada to the Bear River in southwestern Wyoming and the head of the Lost Rivers in southcentral Idaho; southeastern Oregon (acc. Peck, 1941, p. 450); east in Utah (becoming rarer) to the Sevier Valley, and south (often intergrading with var. *scaposus*) to both rims of the Grand Canyon in northwestern Arizona.—Map No. 154.—May to early July.

ASTRAGALUS CALYCOSUS (with conspicuous calyx, not especially apt) Torr. ex Wats., Bot. King 66, Pl. X, figs. 4–7. 1871.—“Found in the West Humboldt, East Humboldt, and Clover Mountains, Nevada... also by Dr. Torrey, in flower only, in Western Nevada... (257).” Lectotypus, *Watson* 257, from the East Humboldt Mountains, July, 1868, US! isotypi, GH (in part, mixed with var. *mancus*), NY!—*Tragacantha calycosa* (Torr. ex Wats.) O. Kze., Rev. Gen. 943. 1891. *Hamosa calycosa* (Torr. ex Wats.) Rydb. in Bull. Torr. Club 54: 17. 1927.

Astragalus brevicaulis (short-stemmed) A. Nels. in Bot. Gaz. 26: 9. 1899.—“... southern Wyoming... Type specimen no. 4601, from near Fort Bridger, June 9, 1898.”—Holotypus, RM! isotypi, NY, US!



Map No. 154. Nevada, Utah, and parts of adjacent states, and inset, top right, Nevada. Range of *A. calycosus*: ▴ var. *calycosus*; ♀ var. *monophyllidius*; ▲ var. *scaposus* (◊ intergradient with var. *calycosus*); and ♣ var. *mancus*.

The Torrey milk-vetch, var. *calycosus*, is most commonly encountered in the form of little tufted plants scattered among the sagebrush, each composed of some three to a dozen crowns which are clustered on a taproot rarely attaining the thickness of a pencil. Although decidedly perennial, plants of this type probably endure for only a few years; a prolific crop of flowers and seeds ensures propagation of their kind in favorable seasons. In central Nevada, particularly on calcareous knolls in the higher valleys, var. *calycosus* is represented by a pulvinate phase in which the older plants may consist of several hundred greatly congested leafy crowns. These are elevated on an elaborately forking, clay-impacted caudex and anchored to the ground by a thick trunklike caudex, which must require a decade or more to reach its full development. The mounded form of the Torrey milk-vetch is often associated with other *polsterpflanzen* (notably *Lepidium nanum* Wats., *Leptodactylon caespitosum* Nutt., *Phlox* species, and a parallel development of *Oxytropis oreophila* Gray—cf. Barneby, 1952, p. 214) and is interpreted as an ecotype or minor variant, since no difference can be found in the reproductive parts. From central Nevada northward and eastward the flowers of var. *calycosus* are most commonly whitish, although often faintly tinged or veined in early anthesis with flesh-pink or rosy-lavender; occasional forms with the banner margined or suffused with lively purple or magenta occur as far north as the Snake River and southwestern Wyoming, as in the typus of *A. brevicaulis*. Southward the flowers are almost consistently bicolored, with white or whitish wing-tips contrasting with a highly colored banner and keel-tip. No correlation has been found between pigmentation of the flowers and type of soil, although possibly the most brightly tinted forms occur only on sedimentary formations.

On the upper Humboldt River in Nevada, and thence northward and eastward, the wing-petals of var. *calycosus* nearly always bear a minute appendage in the sinus between the apical lobes. The appendage takes two forms, appearing either as a threadlike structure arising in the notch and directed forward between the lobes, or as a flat, subulate auricle produced from the base of the interior lobe and directed backward or more commonly across the opposite lobe on the petal's inner face. Transitions between the two sorts are often observed, and the whole appendage varies from a rudiment up to 1.1 mm. long. Within the same northern area the flowers tend to be a little larger than they are southward, with banner 11–16.5 mm. and keel 8–11.6 mm. long; in eastern California and across central Nevada to Utah and Arizona, the banner is commonly only 10–13 mm. and keel 7.4–9.4 mm. long. While of some interest as evidence of incipient racial differentiation, the characters noted are too slight and too feebly expressed to be of taxonomic value, especially when occasional examples of small-flowered individuals or colonies are known from both sides of the Snake River Plains. A remarkably showy variant of var. *calycosus*, with banner up to 20.8 mm. long (and other petals, as noted parenthetically in the foregoing description, in proportion), has been collected near Pocatello, Idaho (*Christ & Ward 7122*, ID, NY); although the wings lack appendages, the plants appear not to differ significantly from sympatric forms of typical *A. calycosus*.

In southeastern Nevada and adjoining Utah and Arizona, var. *calycosus* passes by degrees into var. *scaposus*. While some colonies are precisely typical, occasional individuals or small colonies are characterized by unusually short calyx-lobes, or exerted (but commonly decumbent) scapes, or by leaflets and flowers abnormally numerous. Some of these can be assigned to a varietal category only by arbitrary judgment.

No specimen of *A. calycosus* actually collected by Torrey in Nevada has been seen either at GH or in the Torrey herbarium (NY), despite Watson's report. The plant to which Torrey originally applied the epithet *calycosus* is probably that collected by Stretch at a place called the "Kaolin Hills" (NY), a name not found on modern maps.

337b. ASTRAGALUS CALYCOSUS var. MONOPHYLLIDIUS

Habit of var. *calycosus*; leaflets solitary, terminal, 4–16 mm. long; apical sinus of the wings unappendaged; petals pink-purple.—Collections: 5 (iii); representative: *Eastwood & Howell 9395* (CAS, WS); *Ripley & Barneby 3550* (CAS, RSA), 6255 (RSA).

Open gravelly hillsides, in scattered juniper and piñon forest, on limestone, 5600–6500 feet, forming colonies but known only from a restricted area in north-eastern Nye and Eureka Counties, eastcentral Nevada.—Map No. 154—May and June.

ASTRAGALUS CALYCOSUS var. MONOPHYLLIDIUS (Rydb.) Barneby in Leaf. West. Bot. 3: 107. 1942, based on *Hamosa monophyllidia* (with one leaflet) Rydb. in N. Amer. Fl. 24: 421. 1929.—"... in the vicinity of Currant, Nevada, May, 1916, *Georgia H. Bentley*."—Holotypus, NY! isotypi, DS, MO!

Differing from the nearly sympatric forms of the Torrey milk-vetch only in the loss of the last lateral pair of leaflets in all (or all but a very few) leaves, var. *monophyllidius* is but a minor, and most probably a very recent modification, scarcely deserving taxonomic recognition. The colonies of plants known to me along Currant Creek and on the slope falling eastward from Pinto Summit in Eureka County are essentially uniform, however, and seem to replace typical var. *calycosus* in their area of dispersal.

337c. *ASTRAGALUS CALYCOSUS* var. *MANCUS*

Diminutive in stature (rarely somewhat drawn out in shade); *leaves* 1.5–3 (4) cm. long with 7–13 oblanceolate, elliptic, or narrowly obovate, obtuse or rarely retuse leaflets 2–6 mm. long, crowded on a rachis 1 (1.3) cm. long or less; *peduncles* subfiliform, 2–4.5 cm. long; *racemes* (1) 2–4-flowered; *calyx* 5–8.5 mm. long, the tube 4–5.5 mm., the teeth 1–3 mm. long; petals whitish, the banner 11–13 mm. long; *wings* about as long, the terminal lobes 1.4–2.7 mm. long, either naked or minutely appendaged in the sinus (the appendage not over 0.4 mm. long); *keel* 9–10.2 mm. long.—Collections: 13 (i); representative: *Clokey 5516* (CAS, NA, NY, OB, RSA, SMU, WIS, WS); *Maguire & Holmgren 21,885* (NY, WS, WTU), *22,076* (NY, WTU), *25,816* (NY, RSA); *Cottam 3310* (POM).

Barren rocky ridges at or near the limit of trees, descending on open slopes into clearings of yellow pine forest, commonly but not quite exclusively on limestone, (7700) 8400–13,000 feet, scattered in the higher mountain ranges of Nevada (Charleston and Sheep Ranges, Clark County; Toquima Range, Nye County; Ruby Mountains, Elko County; Mount Wheeler, White Pine County) and adjoining Utah (Deep Creek Range, Juab County).—Map No. 154.—May to August.

ASTRAGALUS CALYCOSUS var. *MANCUS* (Rydb.) Barneby in Leaf. West. Bot. 7: 195. 1954, based on *Hamosa manca* (defective, the allusion not explained) Rydb. in Bull. Torr. Club 54: 17. 1927.—“Clover Mountains, near Deeth [err. “Death”], Nevada, July 24, 1908, *Heller 9163*; apparently also in the Charleston Mountains, Clark County, *Heller 11032*.”—Holotypus (*A. A. Heller 9163*), NY! isotypi, NA, US!—*Astragalus mancus* (Rydb.) Wheeler in *Rhodora* 40: 136. 1938.

Taking into account the degree of variation already noted in var. *calycosus*, one might logically interpret *Hamosa manca* as no more than a montane ecotype of its species, and such it may prove to be. However, the existence of two well-differentiated forms of the Torrey milk-vetch is impressively demonstrated on the east slope of the Charleston Mountains. In this industriously botanized range of mountains, where intermediates between var. *calycosus* and var. *mancus* should, if they exist, already have come to light, the typical form of the species is known to occupy a belt between 6000 and 7400 feet elevation in the piñon-juniper forest, whereas var. *mancus* first appears in the ponderosa pine forest at about 8500 feet and has been traced upward to timber line. Elsewhere the two varieties are not so clearly divided by life-zone. A collection from 11,000 feet in the Toiyabe Range (Stewart Creek, *Maguire & Holmgren 25,927*, RSA), although suggestive of var. *mancus* in its slender habit, has leaflets too large and too few for the present variety and is technically inseparable from var. *calycosus*, which rarely extends elsewhere above the 8000 foot contour. It should be emphasized that short calyx-teeth (“deltoid, 1 mm. long,” Rydb., ex char.; “1–1.5 mm. long,” Clokey, 1942, p. 213) no longer serve as a reliable criterion for var. *mancus*.

In the Charleston Mountains the wing-petals of var. *mancus* are minutely appendaged in the apical sinus; those of var. *calycosus* are simply notched. Farther north, where var. *calycosus* is appendaged, it is var. *mancus* (at least in the Toquima Range and the type-locality) that has naked sinuses.

337d. *ASTRAGALUS CALYCOSUS* var. *SCAPOSUS*

Cespitose, forming tufts or small clumps, but of more erect and commonly looser growth than var. *calycosus*; *petals* pink-purple except for the white wing-tips; *banner* 10.5–14 mm.; *keel* 7.5–9 (10) mm. long; *wings* 9–12 mm. long, the terminal lobes 0.7–2.2 mm. long, the sinus unappendaged; otherwise as described in the key.—Collections: 45 (xi); representative: *Cutler 4656* (NY, SMU, WS);

A. & R. Nelson 2045 (NY, SMU); *Ripley & Barneby 4312, 8404, 12,619* (CAS, RSA); *C. F. Baker 409* (POM, bearing an unpublished epithet ("cyanosemius") attributed to Greene).

Sandy or gravelly hillsides, plains, and mesas, chiefly on sandstone and limestone, forming colonies and locally abundant in juniper or piñon-juniper forest between 4400 and 6200 feet in the drainage of the Colorado, Little Colorado, and San Juan Rivers, from southeastern Nevada across northern Arizona to southwestern Colorado and northwestern New Mexico; in Arizona extending south to the Salt River in Gila County and to the upper Verde River in Yavapai County, in the latter region occurring in mesquite-grassland at about 3300 feet; reported on questionable authority from the Rio Grande Valley in Socorro County, New Mexico (*Plank in 1895*, NY) and from the Huachuca Mountains in southern Arizona (*Wilcox in 1893*, NY).—Map No. 154.—April to June.

ASTRAGALUS CALYCOSUS var. *SCAPOSUS* (Gray) Jones in Zoë 4: 26. 1893, based on *A. scaposus* (scapose, of the peduncles) Gray in Proc. Amer. Acad. 13: 366. 1878.—"... Mokiak Pass, near the northeastern [properly northwestern] corner of Arizona, Dr. E. Palmer ..."—Holotypus, *Palmer 107 in 1877*, GH! isotypi, K, NY!—*Hamosa scaposa* (Gray) Rydb. in Bull. Torr. Club 32: 659. 1905.

Astragalus candicans (white) Greene in Bull. Calif. Acad. Sci. 1: 156. 1885.—"Northern Arizona, 1883, Dr. H. H. Rusby."—No typus found at CAS, ND, UC, or US, the holotypus probably originally at CAS but lost in the 1906 fire; neotypus, collected in Hell's Canyon, apparently near Fort Verde, Yavapai County, Arizona, *Rusby 580*, NY!

If the type-collection were biologically typical of var. *scaposus*, the variety might be considered endemic to northwestern Arizona, about the headwaters of the Verde River and on the limestone plateaus north and south of the Colorado River just below the Grand Canyon. Only in this comparatively small area does the average plant (and even there not every individual) possess in combination all the extreme characteristics claimed for var. *scaposus*: leaves with 4–6 pairs of spaced leaflets, tall scapes bearing loose, several-flowered racemes, and calyx-teeth less than 2 mm. long. As we follow var. *scaposus* eastward across Arizona, we find that the average plant is of lower stature, sometimes as dwarf as typical var. *calycosus*, but the comparatively many leaflets and short calyx-teeth thought proper to var. *scaposus* become more constantly associated. Under high desert conditions in the Four Corners country *A. calycosus* is represented by a form with short calyx-teeth and stiff, more or less erect but quite short scapes and leaves with only 3–5 leaflets. This ambiguous form (cf. *Ora Clark 16,223*, herb. Univ. New Mex.) might be referred on technical grounds to var. *calycosus*. Along streams tributary to the Colorado from the north in southwestern Utah and adjoining Nevada, the average plant of the Torrey milk-vetch falls neatly between the ideal concepts of vars. *calycosus* and *scaposus* formulated in the key. At the Grand Canyon precisely typical var. *calycosus* is found along a strip of limestone pavement on both rims but is replaced within the canyon itself (cf. *Eastwood 9544*, CAS, etc.) by forms variously transient to var. *scaposus*.

The var. *scaposus* is ordinarily the handsomest form of the Torrey milk-vetch. It is more conspicuous than var. *calycosus* not only because of its greater stature and upstanding inflorescence, but because of its more numerous and more brightly colored flowers. On the Peach Springs plateau and sometimes elsewhere the banner and keel are of a vivid magenta-purple which assumes, by contrast with the white wing-tips, a luminous brilliance in the clear desert light.

The doubtful records listed above require verification by new collections. Wilcox is known to have visited Fort Verde as well as Fort Huachuca on his tour of duty in Arizona, and his specimens may have been mislabeled. At least some of Plank's plants ostensibly collected at Socorro must have come from points distant from the town (e.g., *Silene Plankii* Mag. & Hitchc.).

LXXXII. Sectio GREGGIANI

Cauliscent perennials, with subterranean root-crown; *vesture* basifixed, pilosulous; *stipules* dimorphic, the lowest connate; *leaves* imparipinnate, with 13–21 leaflets; *flowers* loosely racemose, spreading or declined, small, the broadly ovate, abruptly recurved banner $\pm$ 7–10 mm. long, the keel-tip sharply deltoid; *calyx*—

tube shallowly campanulate, the teeth as long or longer; *petals* pale purple; *pod* spreading or declined, persistent, sessile, narrowly oblong or lance-oblong in profile, strongly compressed-triangular, grooved dorsally, fully bilocular; *ovules* 9–18.—*Sp.* 1, apparently sometimes mesophytic, of Coahuila.

ASTRAGALUS sect. GREGGIANI, sect. nov., inter *Strigulosos* et *Leptocarpos* quasi intermedia, illos caudice subterraneo, stipulis imis inter se coadunatis et legumine persistenti, hos legumine sessili de latere atque triquetrum compresso simulantes. Tubus calycinus brevissime campanulatus, pubes patule pilosula, habitusque totus unice sectionis speciei peculiares.—*Sp.* typica (unica): *A. Greggii* Gray.

The proposal of another monotypic section to accommodate the peculiar *A. Greggii* requires no apology, for it presents a remarkable combination of characters and has no close relative. The subterranean root-crown, connate lower stipules, and persistent pod are technically in harmony with sect. *Strigulosi*, but *A. esperanzae* alone of that group has an incurved, sessile pod at all similar in external form, and this is very different in habit and in form of the flower. The narrowly lance-oblong, strongly compressed-triangular pod of *A. Greggii*, which secured for it a place in Jones's sect. *Micranthi* and in Rydberg's *Hamosa* sect. *Tricarinatae*, is essentially like that of our sect. *Leptocarpi*, although none of these have connate stipules or buried crown. A pod persistent until dehiscence occurs in two *Leptocarpi*, the annual *A. Nuttallianus* and perennial *A. coahuilae*, but these are quite different in shape and proportion of the petals and in habit of growth. The most immediately striking, even if not fundamental feature of *A. Greggii* is the pubescence of horizontally spreading or somewhat retrorse hairs, found in no other Mexican *Astragalus*; while the shallow, almost bowl-shaped calyx-tube and its long, slender teeth separated by wide, rounded sinuses, together with a broad, abruptly recurved banner and sharply deltoid keel-tip, ensure recognition of the species through the flower alone.

338. ASTRAGALUS GREGGII

Slender, diffuse perennial, with a taproot or obliquely ascending root-stock and subterranean root-crown or shortly forking caudex, the stems, leaf-rachises, and peduncles densely pilose-hispidulous with horizontal or retrorsely spreading hairs up to 0.5–0.8 mm. long, the leaves more thinly incurved-strigulose or -hirsutulous, greenish, the leaflets either glabrous or pubescent above; *stems* 1–5 dm. long, simple or at length freely and divaricately branching, abruptly flexuous or zigzag distally; *stipules* dimorphic, those at the lowest, leafless nodes 1.5–2 mm. long, evidently but shortly connate, the median and upper ones lanceolate to deltoid- or lance-acuminate or -caudate, free or nearly so, 2.5–7.5 mm. long, sharply reflexed; *leaves* mostly subsessile, (2) 3–10 cm. long, with (11) 13–19 (21) obovate to broadly oblong, retuse, flat, thin-textured leaflets 3–15 (17) mm. long; *peduncles* spreading or incurved, 2–7 cm. long; *racemes* shortly but loosely 3–8-flowered, the flowers at full anthesis subhorizontal, declined in age, the axis (0.5) 1–2.5 cm. long in fruit; *bracts* membranous, lanceolate, 1.2–2.5 mm. long; *pedicels* early arched outward, at anthesis 0.8–1.5 mm., in fruit thickened, persistent, 1.4–2.4 mm. long; *bracteoles* 0; *calyx* 5–6.5 mm. long, hirsutulous with white hairs, the somewhat oblique disc 0.7–0.8 mm. deep, the shallowly campanulate tube 2.1–2.6 mm. long, 2.3–2.6 mm. in diameter, the slenderly lance-subulate teeth 2.5–3.6 (4) mm. long, separated by rounded sinuses, the ventral pair shortest, the orifice commonly oblique, the whole persistent unruptured; *petals* pale purple, early fading (often appearing ochroleucous when dry); *banner* abruptly recurved through 80–90°, broadly ovate- or suborbicular-cuneate, openly notched, 7.2–10 mm. long, 5.3–7.7 mm. wide; *wings* (a trifle longer or shorter than the banner) 7.3–9.2 mm. long, the claws 1.9–2.5 mm., the lunately oblong-elliptic, obtuse or erose-emarginate blades 6.2–7.5 mm. long, 2–2.6 mm. wide, both incurved but the left one more abruptly so and its inner edge infolded; *keel* 6.1–7 mm. long, the claws 1.9–2.5 mm., the nearly half-circular blades 4.4–5 mm. long, 2.3–2.8 mm. wide, incurved through 100° to the sharply deltoid, sometimes obscurely porrect apex; *anthers* 0.35–0.5 mm. long; *pod* widely spreading-ascending,

horizontal, or declined, sessile, persistent, narrowly oblong or lance-oblong in profile, slightly incurved, 1–1.7 cm. long, 3–4.3 mm. in diameter, strongly compressed-triquetrous, narrowly grooved dorsally, the thin, green, glabrous valves becoming stramineous, papery, lustrous, finely reticulate, inflexed as a complete septum up to 2–2.2 mm. wide; *ovules* 9–18; *dehiscence* and *seeds* unknown.—Collections: 6 (o); representative: Wynd & Mueller 375 (GH, K, NY, US); Pennell 17,497 (NY); Barkley, Webster & Rowell 7201 (TEX).

Moist wooded canyons and along streams in desert mountains, or in light shade of desert shrubs, mostly (perhaps exclusively) on limestone, about 3000–5500 feet, known only from eastern Coahuila (municipios de Múzquiz, Monclova, y Saltillo), apparently not common.—Map No. 155.—May to July and probably intermittently later following summer rains.

ASTRAGALUS GREGGII (Josiah Gregg, 1806–1850, frontier trader, amateur physican, author, traveled widely in n. Mexico) Wats. in Proc. Amer. Acad. 17: 343. 1882.—“In the mountains east of Saltillo (Palmer 238); also collected by Gregg (439), the locality not stated.”—Holo-typus (Palmer 238), collected 6 miles e. of Saltillo, July 17–20, 1880, GH! isotypi, K, NY, PH, US! paratypus, Gregg 439, MO!—*Hamosa Greggii* (Wats.) Rydb. in Bull. Torr. Club 54: 20. 1927.

The Gregg milk-vetch may be recognized at a glance by the dense, hispidulous pubescence of the stems and petioles in contrast to the thinly and shortly hairy, ordinarily greenish leaflets of broad outline and thin texture. The small, loosely racemose flowers of characteristically short and broad proportions appear on the older specimens to have been ochroleucous with a faint brown penciling on the banner, but traces of purplish-pink are found in all recently collected material. The pod of *A. Greggii* is of a common hamosoid type, unusual only to the extent that it is glabrous and continuous with the receptacle, although completely sessile. Presumably it dehiscs apically on the raceme, but fruits mature enough to show the mode of opening and the ripe seeds are still lacking. Collectors have reported *A. Greggii* as occurring in shady or even moist places, and the membranous foliage is what might be expected of a mesophytic astragalus. Probably, however, it is essentially a xerophyte like *A. scalaris* or many *Strigulosi*, species of the Mexican plateau which are in active growth during the hot months coinciding with the rains, and which seem to require more moisture at the root than the vernal flowering and summer-dormant astragali adapted to existence in open desert.

LXXXIII. Sectio MICRANTHI

Caulescent, taprooted perennials, the root-crown or caudex commonly superficial or nearly so, in one sp. subterranean; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 13–31 leaflets; *flowers* (15–95, mostly over 20) disposed in long, narrow, dense or at length open racemes, early reflexed and when approximate retrorsely imbricated, small, the banner 4–9 mm. long; *petals* whitish or purplish, rarely bright purple, the wings nearly as long or a trifle longer than the moderately reflexed banner, the keel much shorter, obtuse; *pod* reflexed, sessile, readily or at least tardily deciduous, mostly small (4–15 mm. long), linear to narrowly lanceolate or obliquely ovate in profile, more or less incurved, sharply compressed-triquetrous or bluntly trigonous, fully bilocular; *dehiscence* apical and through the ventral suture and the septum, after falling; *ovules* (2) 4–18.—Sp. 5 (possibly 6), mostly flowering in summer and fall, 4 xerophytes of the central Mexican plateau extending feebly north into Arizona and New Mexico, 1 mesophyte isolated on serpentine in the California Inner Coast Ranges.

ASTRAGALUS sect. MICRANTHI Gray in Proc. Amer. Acad. 6: 198. 1864, emend. Jones, Rev. Astrag. 272. 1923.—Sp. lectotypica: *A. Hartwegi* Bth.—*Astragalus* sect. *Eremiticus* Sheld. in Minn. Bot. Stud. 1: 1898, nom. nud., an illegitimate substitute.

Hamosa sect. *Hartwegianae* Rydb. in N. Amer. Fl. 24: 432. 1929.—Sp. typica: *H. Hartwegi* (Bth.) Rydb. = *A. Hartwegi* Bth.

The principal features of the *Micranthi* are free stipules and narrow, usually elongate and many-flowered racemes of small, often very tiny flowers which are sharply deflexed at anthesis and, when close together, retrorsely imbricated. The fruit is of the same basic hamosoid form as described for sect. *Leptocarpi*, but is deflexed like the flowers and on the average shorter or more slender. It disjoints upon ripening as in most *Leptocarpi*, but being small and light is sometimes shed only tardily from the receptacle. In the form of the inflorescence and even in the fruit, the *Micranthi* resemble small-flowered *Strigulosi* and *Miselli*. Both these sections are characterized by emmenoloboid fruits; moreover, in the former the lowest stipules are connate-sheathing and in the latter the pod is stipitate, even though quite obscurely so. The members of these groups most likely to be sought among the *Micranthi* have been introduced into the sectional key. The affinity of *A. Daleae* is still doubtful due to absence of fruiting specimens, but it too is mentioned below on account of its general congruence with some *Micranthi* in habit and flowers. The close affinities of sect. *Micranthi* seem to lie in the direction of sect. *Leptocarpi*, but I think it possible that the *Strigulosi* may have had a role in their genesis. This point is discussed further under *A. Hartwegi*.

It is with some misgiving that I have taken up the epithet *Micranthi* for the present section, since the name was evidently suggested in the first place by *A. micranthus* Nutt., our *A. (Leptocarpi) Nuttallianus*. The section as originally conceived by Gray consisted of three groups of species, admittedly "inter se diversae": 1) *A. Hartwegi* and *A. vaccarum*; 2) *A. cobrensis*, of sect. *Strigulosi*; and 3) the annual *A. (Sesamei) Wrightii* with *A. (Leptocarpi) Nuttallianus* and *A. leptocarpus*. It was greatly expanded by Watson (1871, p. 436), who admitted members of our sects. *Malaci*, *Chaetodontes*, *Hesperonix*, *Reventi-arrecti*, and *Atrati*, and even further by Sheldon under the substituted epithet *Eremiticus* (l.c.). At this point the section had lost contact with realities, having become a receptacle for any astragalus with narrow, more or less trigonous pod, a type common to many remotely related species-groups throughout the range of the genus. When Jones came to dismember the *Micranthi*, he transferred *A. cobrensis* to sect. *Strigulosi*, and the annual elements to a new sect. *Leptocarpi*, leaving as a residue only *A. Hartwegi* and *A. vaccarum* to represent the original group. The choice of typus implied by this action must be regretted, especially so since Gray described his *Micranthi* as "mostly annual"; but as it is legally defensible, it must be followed.

Our *Micranthi* form a comparatively small and homogeneous nucleus of species, compared with Jones's section of the same name or Rydberg's technically synonymous sect. *Hartwegianae*. These included many species similar to the genuine *Micranthi* in their small flowers and hamosoid pods, but highly diverse in other respects. They will be found scattered in these pages among sects. *Leptocarpi*, *Strigulosi*, and *Miselli* or referred (as *A. Lemmoni*, *A. Greggii*, *A. hypoleucus*) to monotypic sections.

Key to the Species of Sect. *Micranthi*

1. Stipules all, even at the base of the main stems and low on the branches, free opposite the petiole (or opposite the suppressed petiole); *pubescence* basifixed; *pod* nearly always incurved (at least never decurved) and fully bilocular; genuine *Micranthi* (2)
2. Ovary and pod pubescent, if only thinly so then the ovules over 6; Mexico to s. Arizona and s. New Mexico (3)
3. Bracts linear-lanceolate, subulate, or narrowly triangular-ovate, not boat-shaped; *leaflets* 11–25; *ovules* (2) 4–18 (4)
4. Pod slenderly lanceolate or linear-oblong in profile, 6–15 mm. long, 1.3–2.5 mm. in diameter (5)
5. Calyx-tube 1.7–2 mm. long, symmetric or subsymmetric at base; *banner* 4.2–6.2 mm. long, *keel* 3.2–5.3 mm. long; *pod* 6–12 mm. long; Durango n.-ward (6)
6. Pod exactly sessile, deciduous; *keel* much shorter than the *banner* or wings; widespread 340. *A. vaccarum*
6. Pod very shortly stipitate (the stipe obscure, less than 1 mm. long), persistent; *keel*, wings, and *banner* of nearly equal length (4.9–5.3 mm.); Sierra Surotato, Sinaloa; cf. *A. (Miselli) sinaloa*
5. Calyx-tube 2.2–3.4 mm. long, strongly oblique at base, the pedicel attached at the lower corner or a little above it on the dorsal side; *banner* 7–9 mm. long, *keel* 5.6–6.3 mm. long; *pod* 13–15 mm. long; *ovules* 14–18; San Luis Potosí to Durango, Aguas Calientes, and Hidalgo 339. *A. Hartwegi*
4. Pod plumply half-ovate, half-ovate-acuminate, or ovate-oblong in profile, (3.5) 4–8.5 mm. long, 2–5 mm. in diameter; if in the range of *A. vaccarum*, the pod only 4–6 mm. long (7)
7. Pod plumply half-ovate in profile, 3.5–6 mm. long, 2–2.7 mm. in diameter;

fruiting racemes lax and elongate, the axis 6–18 cm. long; *ovules* 4–8; *stems* from a determinate root-crown at or just below soil-level; s. Chihuahua and Durango.....

341. *A. Goldmani*

7. Pod plumply half-obovoid or obliquely ovoid-acuminate, 6–8.5 mm. long, 2.8–5 mm. in diameter; *fruiting racemes* more compact and shorter, the axis 2.5–5 (7) cm. long; *ovules* 8–13; *stems* from a buried root-crown, subterranean for a space of (1) 2–10 cm.; s. Hidalgo and Mexico.....

343. *A. oxyrrhynchus*

3. Bracts subherbaceous, broadly elliptic, acute or subacute, boat-shaped, 2–4 mm. long, 1–2 mm. wide; *leaflets* 17–31; *ovules* 9–11; Durango; cf. *A. Daleae* in Appendix I.

2. Ovary and pod glabrous; *pod* 4.5–7 mm. long, 4–6-ovulate; California.....

342. *A. Clevelandii*

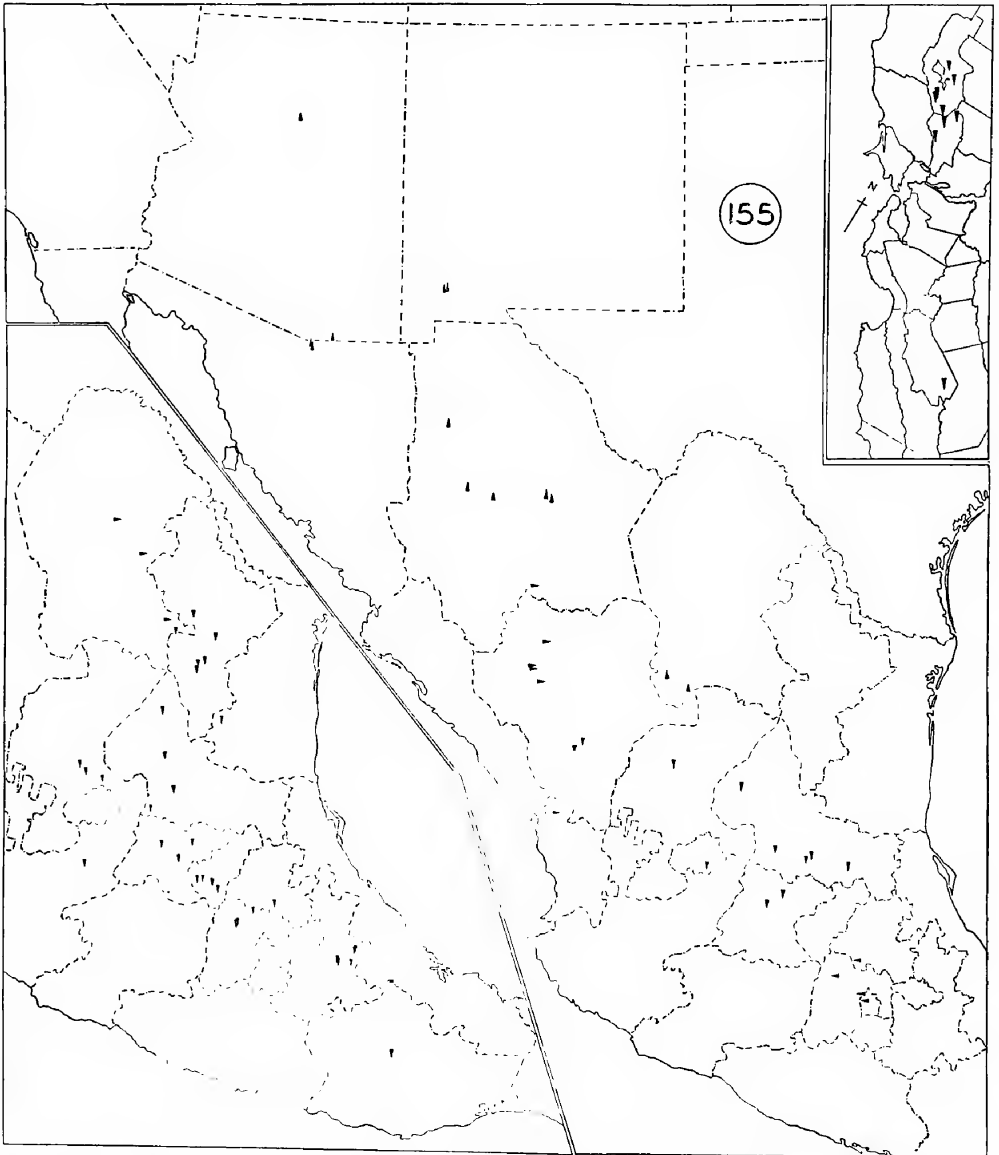
1. Stipules at base of the main stems, and often low on lateral branches, connate at least at base opposite the petiole; if vestiture dolabriform, cf. *A. hypoleucus*; if basifixed, cf. *Strigulosi*, especially *A. micranthus*, with pod often decurved, and commonly semibilocular.

339. ASTRAGALUS HARTWEGI

Cauliscent perennial, with a taproot and root-crown or shortly forking caudex at or just below soil-level, varying from quite slender to comparatively stout and coarse, strigulose with appressed or subappressed hairs up to 0.25–0.5 mm. long, the herbage green or cinereous, the leaflets either glabrous or thinly pubescent above; *stems* seemingly diffuse and incurved-ascending, 1–3 (4) dm. long, slender at base becoming thicker distally, simple, or branched or spurred near the base; *stipules* 1–4 mm. long, subdimorphic, the lowest ones small, scarious, pallid, fully amplexicaul but free, the upper ones triangular or lanceolate, herbaceous or firmly papery, semiamplexicaul, the blades often reflexed; *leaves* (2) 3–9 (15) cm. long, all but the lowest subsessile, with 15–25 (29) oblong or oblong-elliptic to narrowly oblanceolate or almost linear, obtuse or subacute (exceptionally, in some lower leaves, obovate and emarginate), flat or loosely folded leaflets 3–18 (21) mm. long; *peduncles* incurved-ascending, (4) 6–16 (20) cm. long; *racemes* densely or at length loosely (15) 25–55-flowered, the flowers early reflexed, either secund or loosely retrorse-imbricated, the axis more or less elongating, (2) 4–14 cm. long in fruit; *bracts* membranous, pallid, ovate or lanceolate, 1–4 (5) mm. long, early deflexed; *pedicels* arched out- and downward, at anthesis 0.2–0.8 mm., in fruit thickened, persistent, 0.6–1.3 mm. long; *bracteoles* 0; *calyx* 3.2–4.8 mm. long, loosely strigulose with white or largely fuscous hairs, the strongly oblique disc 0.6–0.8 mm. deep, the campanulate tube 2.2–3.4 mm. long, 1.7–2.5 mm. in diameter, obliquely truncate or commonly a little gibbous dorsally at base, the subulate or triangular-subulate teeth 1–1.4 mm. long; *petals* (at least the banner) purplish, drying pallid or bluish; *banner* recurved through 45–50°, rhombic-ovate-cuneate, notched, 7–9 mm. long, 3.8–5.2 mm. wide; *wings* (0.3 mm. longer to 0.4 mm. shorter) 6.6–8.6 mm. long, the claws 2.6–3 mm., the lanceolate, obtuse blades 4.5–6.3 mm. long, 1.2–1.6 mm. wide, gently incurved in the distal half; *keel* 5.4–6.3 mm. long, the claws 2.6–2.9 mm., the half-obovate or obliquely obovate blades 3.1–4.2 mm. long, 1.9–2.1 mm. wide, incurved through $\pm 90^\circ$ to the rounded apex; *anthers* 0.4–0.5 mm. long; *pod* deflexed, sessile, deciduous (sometimes tardily) from the conical receptacle, narrowly lanceolate or linear-oblong in profile, gently incurved or almost straight, 1–1.5 cm. long, 1.8–2.4 mm. in diameter, rounded at base, contracted into a short subulate cusp at apex, trigonously compressed, carinate ventrally by the suture, openly sulcate dorsally, the thin, green, strigulose valves becoming papery, stramineous or ultimately blackish, delicately cross-reticulate, inflexed as a complete or almost complete septum 0.8–1.2 mm. wide; *dehiscence* apical and downward the length of the ventral suture, and ultimately through the septum, the halves of the pod tardily separating;

ovules (12?) 14–18; *seeds* brown or olive-brown, heavily purple-speckled, often prismatically compressed, smooth and sublustrous, 1.2–1.5 mm. long.—Collections: 14 (ii); representative: *Palmer* 290 (GH, NY, US); *Purpus* 5195 (GH); *Parry & Palmer* 168 (GH); *Palmer* 65 & 81 (GH, NY); *Rose & Hay* 5286 (US); *Waterfall* 15,520 (NY).

Plains and hillsides, ranging from arid grassland at 3000 feet into open oak woodland and pine forest as high as 8200 feet, not uncommon in northcentral Mexico, from near Ciudad Durango south and southeast to Guanajuato, and through San Luis Potosí to Hidalgo.—Map No. 155.—June to October.



Map No. 155. Center, parts of Mexico and southwestern United States. Range of $\blacktriangledown$ *A. Hartwegi*; of $\blacktriangle$ *A. vaccarum*; of $\blacklozenge$ *A. Goldmani*; and of $\blacklozenge$ *A. oxysrhynchus*. Top right, central California. Range of *A. Clevelandi*. Bottom left, parts of central and northeastern Mexico. Range of $\blacktriangledown$ *A. hypoleucus*; and of $\blacklozenge$ *A. Greggii*.

ASTRAGALUS HARTWEGI (Karl Theodor Hartweg, 1812–1871, collected extensively in California and Mexico) Bth., Pl. Hartw. 10. 1839.—No locality given, but the plant found in Hartweg's collection of 1837, gathered on the road between Mexico City and Zacatecas.—Holotypus, *Hartweg 53*, labeled "Aguas Calientes," K (herb. Bth.)! isotypi, BM, G, GH, OXF, P!—*Tragacantha Hartwegi* (Bth.) O. Kze., Rev. Gen. 945. 1891 ("*Hartwegii*"). *Hamosa Hartwegi* (Bth.) Rydb. in Bull. Torr. Club 54: 333. 1927 ("*Hartwegii*").

Hamosa hidalgensis (of Hidalgo) Rydb. in Bull. Torr. Club 54: 333. 1927.—"Type Pringle 9720 (herb. N. Y. Bot. Gard.) was collected at Dublan, Hidalgo, September 19, 1902..."—Holotypus, NY! isotypi, GH, K, US!

The Hartweg milk-vetch, one of several Mexican *Astragali* with many tiny, reflexed flowers arranged in long, rat's-tail spikes, is characterized by rather minute technical features and has been confused repeatedly with the closely related *A. vaccarum* and with *A. (Strigulosi) micranthus* var. *micranthus*. These three species have not been clearly separated since 1881, when Hemsley in *Biologia Centrali-Americana* cited as *A. Hartwegi* material of *A. vaccarum* from Sonora (Schott) and of *A. micranthus* from near Mexico City (Bourgeau 337, 483). The dispersal northward "probably to Chihuahua" attributed to *A. Hartwegi* by Jones (1923, p. 278) is certainly based on mistaken identities, chiefly involving *A. vaccarum*. Finally Rydberg's *Hamosa Hartwegi* (l.c.) can be analysed into the same three components, all material cited from Chihuahua, Sonora, and Coahuila representing *A. vaccarum*, whereas the Bourgeau and Arsène collections from Hidalgo and the Federal District are *A. micranthus*. The differential characters of *A. vaccarum*, already brought out in the sectional key and discussed under the following species, need not detain us here. Those of *A. micranthus* are easily observed only in complete and carefully collected specimens which show the connate lower stipules of sect. *Strigulosi* and, if possible, the mature pod. The fruit of var. *micranthus* is variable in size and curvature, but it resembles that of *A. Hartwegi* really closely only in a small proportion of the specimens examined, those representing the form that has been called *A. saltonis* Jones. But even in these the pod remains attached to the receptacle until dehiscence and, as compared with that of genuine *A. Hartwegi*, is of perceptibly thinner texture and less sharply trigonous compression, having blunter lateral angles and more convexly rounded lateral faces. In most forms of *A. micranthus* the ovules are 4–7 pairs, whereas 7–9 pairs are commonest in *A. Hartwegi*; this character is indecisive, but often useful. While two perfectly distinct species unquestionably exist, I must admit that they are often astonishingly alike in growth-habit and even in fine detail of the floral structure. The similarities are of a sort to challenge the validity of a phylogenetic system which contrives to refer the two species to different sections and implies a widely separated origin for each. It is an accepted fact that pairs of organisms may mimic each other by means of evolutionary convergence, but it is difficult to prove convergence in members of the same genus, where a similar facies is more likely than not to denote a genuinely close relationship and near common origin. However there can be no reasonable doubt that *A. Hartwegi* forms with *A. vaccarum* and *A. Goldmani* a natural group of piptoloboid species allied to sect. *Leptocarpis*; and it seems equally sure that *A. micranthus* is a true member or the emmenoloboid sect. *Strigulosi*, with close relations in *A. Purpusi* and *A. pueblae*. If the deep dichotomy assumed to exist between the emmenoloboid and piptoloboid phyla in *Astragalus* corresponds with a historic reality, *A. micranthus* and *A. Hartwegi* ought not to be near allies but simply a convergent pair. Possibly, however, the skein is not so simply woven; it is suspected that anastomosing strands crossed over in the past from one major gene-stream into another, giving rise to bridges and confusing passages between the main lines of heredity in the genus, which have elsewhere remained, broadly speaking, intact and pure. If it is possible to conceive of introgression between the forebears of the small-flowered *Strigulosi* and the *Micranthi*, characterized on the one hand by buried root-crown, connate stipules, and persistent pod, and on the other by superficial crown, free stipules, and deciduous fruit, we should expect to find various combinations of these characters handed down to contemporary forms. It is perhaps no coincidence that two astragali flourishing today on the Mexican Plateau fulfil just these conditions, and at the same time have tiny, reflexed flowers and small, bilocular fruits quite similar to those of *A. Hartwegi* and *A. micranthus*. These two are *A. oxyrrhynchus*, which has all characters of the *Micranthi* except the buried root-crown, a feature very rarely combined with free stipules; and *A. hypoleucus*, closely resembling the last-mentioned except for the sheathing stipules, and thus suggesting a member of sect. *Strigulosi* with disjointing pod. I cannot help suspecting that all share in a common heritage. The situation is perhaps analogous with that described in connection with sects. *Trichopodi* and *Oxyphysi* in California.

Variation in *A. Hartwegi* is of a superficial nature involving stature and vigor, width of leaflets, and size or curvature (or both at once) of the pod, which may be straight or gently incurved. The vesture of the herbage varies in dispersal over the leaflet surface, and in color on the calyx and pedicel. A robust plant with relatively small flowers and dark-hairy inflorescence

was singled out by Rydberg to typify his *Hamosa hidalgensis*, but it is only one of several known minor variants. The only other collection (*Rose* 2757 from Plateado, Zacatecas) associated by Rydberg with *H. hidalgensis* represents *A. esperanzae*. A topotypus of *H. hidalgensis* with paler vestiture (*Rose & Hay* 5286, US) was annotated by Rydberg himself as *H. Hartwegi*.

The Hartweg milk-vetch was collected first late in the XVIII century by Sessé & Mocino (OXF).

340. ASTRAGALUS VACCARUM

Slender, erect or diffuse, from an oblique or vertical taproot and ultimately knotty root-crown, strigulose with straight, appressed or narrowly ascending (rarely some spreading) hairs up to 0.4–0.8 (1) mm. long, the herbage green or (when young) subcinereous, the leaflets glabrous or nearly so above; *stems* (1) 1.5–4.5 dm. long, simple, or spurred (branched) at 1–4 nodes preceding the first peduncle, floriferous upward from (3) 5–8 nodes beginning at or below the middle; *stipules* 2–8 mm. long, the lowest small, early becoming papery, deciduous in age, the upper ones longer, subherbaceous, narrowly lanceolate to deltoid-acuminate, usually erect, glabrous or nearly so dorsally, ciliate and sometimes beset with a few minute glandular processes; *leaves* 4–12 cm. long, slenderly short-petioled or the upper ones subsessile, with (9) 11–21 (23) linear-oblong to narrowly elliptic, acute, or obtuse and shortly mucronulate-acuminate, flat or loosely folded leaflets (3) 5–20 (24) mm. long; *peduncles* (2.5) 5–12 cm. long, mostly as long or a little longer than the leaf, erect or incurved-ascending; *racemes* (10) 15–50-flowered, dense at early anthesis, the flowers early reflexed and often retrorsely imbricated, becoming interrupted in fruit, the axis more or less elongating, at length (1.5) 3–8 cm. long; *bracts* membranous, pallid, lanceolate or linear, 1–3 mm. long, reflexed in age, sometimes deciduous; *pedicels* early arched out- and downward, at anthesis 0.3–0.5 mm., in fruit thickened, persistent, 0.7–1.2 mm. long; *bracteoles* 0–2, minute when present; *calyx* 2.5–3.6 mm. long, strigulose with white, black, or mixed hairs, the subsymmetric disc 0.3–0.5 mm. deep, the campanulate tube 1.7–2 mm. long, 1.6–2 mm. in diameter, the subulate teeth 0.8–1.8 mm. long, the whole becoming papery, ruptured, marcescent; *petals* usually purple or purple-tinged, when pale quickly fading in the herbarium and appearing ochroleucous, perhaps sometimes truly so, the banner sometimes striate, the wing-tips sometimes paler or white; *banner* recurved through 45–90°, mostly ovate-cuneate, rather deeply notched, 4.2–6.2 mm. long, (2) 2.3–4 mm. wide; *wings* (as long or up to 1 mm. longer) 4.9–6.4 (7) mm. long, the claws 1.6–2.1 (2.5) mm., the narrowly oblong-elliptic or oblanceolate, obtuse blades (3.4) 3.6–4.8 mm. long, 1.2–1.9 mm. wide, both equally and gently incurved or the left (rarely right) one more abruptly and further than the other; *keel* 3.7–5 mm. long, the claws 1.7–2.3 mm., the half-obovate blades 2–3.3 mm. long, 1.6–2 mm. wide, incurved through 90–125° to the rounded apex; *anthers* 0.3–0.35 mm. long; *pod* deflexed, sessile on the slightly produced receptacle and rather tardily disjoining, narrowly lanceolate or linear-elliptic in profile, evenly incurved through about 1/8–1/4 circle, 6–12 mm. long, 1.3–2 mm. in diameter, rounded at base, contracted at apex into a short, erect or slightly declined, cusplike beak, otherwise triquetrously compressed, carinate ventrally by the salient suture, sulcate dorsally, the lateral faces nearly flat, the lateral angles rounded, the thin, pale green, white- or partly black-strigulose valves becoming papery, stramineous, delicately reticulate, inflexed as a wide but sometimes incomplete septum 0.5–1 mm. broad; *dehiscence* primarily apical, after falling; *ovules* 6–10; *seeds* purplish-brown, or brown speckled with purple, smooth and sublustrous, about 1.3–1.5 mm. long.—Collections: 13 (o); representative: *LeSueur* 687 (CAS, GH, SMU, TEX); *Pringle* 1217 (GH, ND, NY, US); *Palmer* 235 (GH), 395 (GH, NY, US); *Thurber* 1051 (GH, NY).

Dry flats and benches in oak-pine forest, descending (apparently along streams, but not a true mesophyte) to summer-moist flats on the valley floor, about 4000–7500 feet, fairly frequent in the Sierra Madre Occidental from northern Durango north through Chihuahua to southwestern New Mexico, southeastern Arizona, and adjoining Sonora, and extending east into the region of Bolsón de Mapimí in southern Coahuila.—Map No. 155.—June to October, or sometimes April–June.

ASTRAGALUS VACCARUM (of cows, from the type-station) Gray, Pl. Wright. 2: 43. 1853.—“Ojo de Vaca, west of the copper mines, New Mexico, Aug. [Wright] 1002.”—Holotypus, collected in 1851, GH! isotypi, K, NY, PH, US!—*Tragacantha vaccarum* (Gray) O. Kze., Rev. Gen. 949. 1891. *Hamosa vaccarum* (Gray) Rydb. in Bull. Torr. Club 54: 334. 1927.

Astragalus militaris (of Soldier Canyon) Jones, Rev. Astrag. 278, Pl. 70. 1923.—“Soldier Canon near Colonia Juarez Chihuahua Mexico, Sept. 16, 1903, Jones . . .”—Holotypus, POM! isotypi, NY, US!—*Hamosa militaris* (Jones) Rydb. in Bull. Torr. Club 54: 332. 1927.

In the northern Sierra Madre the Cow Spring milk-vetch is quickly identified by its dense racemes of tiny flowers which are succeeded by small, deflexed pods of the hamosoid type; the remaining small-flowered species of the region, other than *A. Goldmani*, have a fruit stipitate if trigonously compressed and unilocular if sessile. The closely related *A. Goldmani*, a comparatively local species of southern Chihuahua and Durango, is usually a more densely and loosely pubescent plant; however the vesture is by no means decisive so that the short and plump, few-ovulate pod is required for definite determination. The species most nearly resembling *A. vaccarum* is *A. Hartwegi*, but the shorter flower with less oblique calyx and the shorter, fewer-ovulate pod of usually very slender outline are distinctive. Because of the smallness of the flowers in the *Micranthi*, differences in length of petals are naturally not large, except in proportion to the whole, and are best observed in carefully dissected flowers. Jones (1923, p. 279), Rydberg (1927, p. 334) and others have questioned whether *A. vaccarum* was more than a form or variety of *A. Hartwegi*; as the material of the two species has not been disentangled till now, their verdict is not surprising. The Cow Spring milk-vetch is variable in the color of the flowers and of the hairs in the inflorescence, but I have no information as to whether these vary within a colony of plants or only from one colony to another. The type-collection of *A. militaris* has flowers of a relatively deep purple shade, and Rydberg maintained *Hamosa militaris* as distinct from supposedly white-flowered *H. vaccarum* on the basis of this one character; the plant does not differ perceptibly from the majority of collections from Chihuahua and cannot be considered as more than a very minor variant at best. In the Sierra Madre and in Arizona and New Mexico, *A. vaccarum* flowers during the summer and fall months, depending on the seasonal rains, and I find no record of vernal forms from this region. In southern Coahuila, especially around the edge of Mapimí Basin, there occurs a relatively coarse plant of the *vaccarum* type which has been collected in flower as early as April and in fruit by June (cf. Gregg, from Rio Nazas, in 1847, NY; Palmer 235, from San Lorenzo de Laguna, GH). The ecology of these populations has not been recorded; their status cannot be determined without further study. They have been mapped provisionally as representing *A. vaccarum*.

Although common in Chihuahua, *A. vaccarum* extends only rarely northward into the United States. I have no record from New Mexico later than those of Wright and Thurber, from Ojo de Vaca and Apache Tejú, now over one hundred years old. Kearney & Peebles (1951, p. 468) cited both *A. Hartwegi* and *A. vaccarum* (in a form with purple flowers) as found in Arizona, the former collected by Lemmon in Cochise County, the latter by Thornber near Flagstaff. Thornber's plant (ARIZ) is typical *A. vaccarum* with rather bright purple flowers. That of Lemmon (No. 2658, from the Babocomori, G, P, or perhaps the Huachuca Mountains, K) is the commoner phase of *A. vaccarum* with petals of a pallid purplish hue.

341. *ASTRAGALUS GOLDMANI*

Slender perennial, with a taproot and ultimately knotty root-crown, rather densely strigulose or strigose and villosulous with straight and subappressed or almost wholly quite appressed, or sometimes with largely sinuous and spreading hairs up to 0.5–0.9 (1) mm. long, the stems and herbage cinereous or canescent, the leaves sometimes greenish, the leaflets glabrous, medially glabrescent, or rarely pubescent above; stems rather few, erect or ascending, 1.2–4 dm. long, simple or branched from 1–5 nodes preceding the first peduncle, floriferous from about 5–8 nodes upward from near or below the middle; stipules 1.5–6 mm. long, the lowest firmly papery, the upper ones herbaceous, triangular-acuminate or lanceo-

late, semiamplexicaul; *leaves* 1.5–9 cm. long, the lowest petioled, the rest sessile, with (13) 15–21 oblanceolate, elliptic-oblanceolate, or linear-elliptic, acute, subacute, or obtuse, flat or loosely folded leaflets 2–10 mm. long; *peduncles* erect or incurved, 3–10 cm. long, nearly always longer than the leaf; *racemes* (13) 20–60-flowered, the flowers early declined, at first approximate but soon scattered, the axis 6–18 cm. long in fruit; *bracts* submembranous, pallid, linear-lanceolate or subulate, 1.5–2.3 mm. long, deflexed in fruit; *pedicels* early recurved, at anthesis 0.3–0.5 mm. long, in fruit somewhat thickened, persistent, 0.8–1 mm. long; *bracteoles* 2, minute; *calyx* 2.7–3.6 mm. long, loosely strigulose or hirsutulous with white, black, or mixed hairs, the subsymmetric disc 0.4–0.6 mm. deep, the campanulate or turbinate-campanulate tube 1.5–2.1 mm. long, 1.4–1.8 mm. in diameter, the subulate or broadly triangular teeth 0.5–1.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* apparently ochroleucous drying yellow or yellowish, perhaps sometimes tinged with purple or purplish-blue; *banner* recurved through $\pm 50^\circ$ (further in withering), ovate-cuneate or rhombic-oblanceolate to -elliptic, shallowly or deeply notched, 4–6 mm. long, 2.4–3.5 mm. wide; *wings* (0.1–0.8 mm. longer) 4.5–6.6 mm. long, the claws 1.6–2.1 mm., the oblanceolate to elliptic, obtuse, gently and evenly incurved blades 2.8–5 mm. long, 1.2–2.1 mm. wide; *keel* 3.7–4.7 mm. long, the claws 1.4–2.2 mm., the half-obovate blades 2.2–2.8 mm. long, 1.4–1.8 mm. wide, incurved through $90\text{--}105^\circ$ to the broadly rounded apex; *anthers* 0.25–0.35 mm. long; *pod* deflexed, sessile, rather tardily deciduous, (3.5) 4–6 mm. long, 2–2.7 mm. in diameter, half-ovate in profile, rounded at base, shortly cuspidate at apex, obtusely triquetrous, keeled ventrally by the straight or slightly concave suture, grooved dorsally, the lateral angles plumply rounded, the thin, green, densely white- or partly black-strigulose valves becoming stramineous and ultimately brownish, papery, inflexed as a complete septum 0.7–2 mm. wide; *dehiscence* through both sutures and the septum, the halves of the pod ultimately separating; *ovules* 4–8; *seeds* olivaceous, purple-dotted, pitted but sublustrous, about 2 mm. long.—Collections: 9 (o); representative: *Palmer* 440, 441 (GH, NY, US); *E. W. Nelson* 4708 (NY, US); *G. L. Fisher* 44,277 (ARIZ, NY, SMU); *Gentry* 6939 (MICH, NY).

In dry grassland and open oak or pine forest, sometimes on volcanic substrata, about 6000–7000 feet, both slopes of the Sierra Madre Occidental, from southcentral Chihuahua to northern Durango; one station in northern Nayarit.—Map No. 155.—July to October.

ASTRAGALUS GOLDMANI (Edward Alphonso Goldman, b. 1873, biologist and conservationist, collected widely in s.-w. United States and Mexico) Jones, Rev. Astrag. 281, Pl. 70. 1923.—“The type is No. 335619 National Herbarium, Goldman’s no. 119 from Parral, Chihuahua, Mexico, September 16, 1898 . . .”—Holotypus, US! isotypus, GH!—*Hamosa Goldmani* (Jones) Rydb. in Bull. Torr. Club 54: 332. 1927.

The Goldman milk-vetch has almost every character in common with *A. vaccarum*, except the greatly shortened and proportionately much broader pod. The vesture of the stems and leaves is commonly denser, varying from almost truly appressed to ascending and twisted, and the racemes elongate considerably during anthesis, the principal ones becoming very long, narrow, and interrupted in fruit. Flowers of almost all extant material appear yellowish or decidedly yellow and may have been ochroleucous when fresh. One recent collection, however, shows traces of bluish-purple on the banner and keel. Color of the petals is variable in sect. *Micranthi*, and the anthocyanin, even when present, is often fugitive.

342. *ASTRAGALUS CLEVELANDI*

Tall, ordinarily robust and leafy, rarely quite slender, with a thick, woody taproot and knotty root-crown or shortly forking caudex just below soil-level, the stems glabrous, the herbage green but strigulose with fine, straight and nearly

straight, appressed or subappressed hairs up to 0.3–0.8 mm. long, the leaflets glabrous or glabrescent above; *stems* several or numerous, erect and ascending in bushy clumps, 3–10 dm. long, simple or (when stouter) spurred or branched at 1–4 nodes preceding the first peduncle, floriferous from above the middle at about 2–10 distal axils; *stipules* submembranous, the lowest becoming papery-scarious, pallid, fragile in age, (2) 3–7 mm. long, deltoid-acuminate, triangular, or lanceolate, embracing or decurrent around less than half, or the lowest around $\frac{3}{4}$ or more of the stem's circumference; *leaves* (2) 4–14 cm. long, shortly petioled or the upper ones sessile, with 13–25 (27) elliptic, narrowly oblong, lanceolate, or oblanceolate, flat, dorsally keeled leaflets (3) 5–23 mm. long, those of the lower leaves commonly obtuse, or subobtuse and mucronulate (exceptionally emarginate), those of the upper leaves fewer, smaller, and often acute or subacute; *peduncles* incurved-ascending, 5–15 cm. long, little or greatly surpassing the leaf; *racemes* loosely, sometimes interruptedly or even remotely 20–95-flowered, the flowers early deflexed, the axis much elongating, 8–30 cm. long in fruit; *bracts* membranous, linear-lanceolate, 1.2–3 mm. long; *pedicels* early arched outward and in age downward, at anthesis 0.6–1 mm., in fruit a little thickened, 1.2–3 mm. long; *bracteoles* 0; *calyx* 3.5–4.4 mm. long, strigulose with white hairs, the subsymmetric disc 0.5–0.8 mm. deep, the campanulate tube 1.8–2.2 mm. long, 1.6–2 mm. in diameter, the slenderly subulate, incurved teeth 1.4–2.2 mm. long, the dorsal one usually longest, the whole becoming papery, ruptured, marcescent; *petals* whitish, immaculate, more or less marcescent and ochroleucous when faded; *banner* abruptly recurved through 45°, further in withering, ovate-elliptic or -cuneate, shallowly notched, 4.8–6 mm. long, 3.2–4.4 mm. wide; *wings* (0.2–1.4 mm. longer than the banner) 5.2–7 mm. long, the claws 1.5–2 mm., the obliquely elliptic, lance-elliptic, or obliquely obovate, obtuse, rather strongly incurved blades 4.1–5.5 mm. long, 1.6–2 mm. wide; *keel* 3.8–4.6 mm. long, the claws 1.6–2 mm., the nearly half-circular blades 2.4–2.9 mm. long, 1.4–1.8 mm. wide, incurved through 100–115° to the bluntly or more often sharply deltoid, slightly porrect apex; *anthers* 0.3–0.4 (0.45) mm. long; *pod* deflexed, sessile, lunately half-ovoid or lance-ovoid, slightly incurved, 4.5–7 mm. long, 1.3–2.3 mm. in diameter, rounded or cuneate at base, shortly cuspidate at apex, triquetrously compressed, carinate ventrally by the prominent suture, sulcate dorsally, the lateral angles obtuse, the green, glabrous valves becoming stramineous, stiffly papery, finely cross-reticulate, inflexed as a complete or subcomplete septum 0.6–1 mm. wide; *ovules* (2) 4–6; *seeds* narrowly oblong, brown, sometimes purple-dotted, smooth and sublustrous, 2.7–3 mm. long.—Collections: 16 (ii); representative: *Abrams* 6269 (NY, US); *M. S. Baker* 10,852 (CAS); *Ripley & Barneby* 6909 (CAS, NY, RSA); *G. S. Lyon* 1912 (CAS).

Sandy stream banks, gravel bars moist in spring, hillside seeps and marshy pockets on open slopes, apparently confined to serpentine, local and rather rare, in two widely separated areas in the inner Coast Ranges of California: between 650 and 3000 feet, in the mountains of northern Napa and southeastern Lake Counties (Mt. Saint Helena and Aetna Springs to Knoxville, north to Mt. Hannah and Mt. Cobb, and up to 5000 feet on Snow Mt.); and at about 4450 feet near the head of San Benito River in the San Carlos Range, San Benito County.—Map No. 155.—June to September.

ASTRAGALUS CLEVELANDI (Daniel Cleveland, 1838–1929) Greene in Bull. Torr. Club 9: 121. 1882.—“Collected in Indian Valley, Lake County, Cal., June, 1882, by Mr. D. Cleveland.”—Holotypus, ND! isotypi, GH, SD!—*Hamosa Clevelandi* (Greene) Rydb. in op. cit. 54: 334. 1927.

The Cleveland milk-vetch, the only astragalus of its type in California, is recognized at a

glance by the long, open racemes of tiny, reflexed, whitish flowers which are followed by small, shining green pods containing only two or three seeds in either chamber. By comparison with the Mexican *Micranthi* it is a coarse leafy plant; vigorous individuals reach a stature of three or even four feet, including the projecting flower-spikes, in favorable places. The species most nearly resembling it in technical characters is *A. Goldmani*, distant nearly a thousand miles southward in Chihuahua, but the relationship is probably not really close. A noteworthy feature of *A. Clevelandi* is its bicentric range, evidence of its relic nature. Presumably the Cleveland milk-vetch formed part of a floristic invasion directed northward from the Mexican plateau, perhaps during one of the warm interglacial periods. Preconditioned to a summer period of bloom, the species has become adapted in the absence of summer rains to a mesophytic habitat. Probably it is only on serpentine, which inhibits the rank vegetation ordinarily found along streams in temperate climes, that an astragalus could find or maintain a foothold in soils even seasonally moist. If this view is correct, the role of serpentine bedrock is here a negative one, and the highly mineralized soils derived from it are not required for successful growth.

343. *ASTRAGALUS OXYRRHYNCHUS*

Low, slender, caulescent perennial, with taproot and subterranean root-crown, strigulose throughout with fine, appressed and subappressed hairs up to 0.2–0.3 (0.4) mm. long, the herbage greenish-cinereous or cinereous, the leaflets glabrous above; *stems* 2–26 cm. long, decumbent and incurved-ascending, buried and leafless for 1–10 cm., commonly branched on emergence, simple thereafter or shortly spurred at 1–3 nodes preceding the first peduncle; *stipules* 1.5–5 mm. long, the lowest papery-scarious or early becoming so, the upper ones subherbaceous, triangular-ovate to lance-acuminate, about semiamplexicaul; *leaves* 2.5–7 (9) cm. long, all but the lowest subsessile, with (11) 13–23 linear-oblong to narrowly oblanceolate, obtuse or retuse, mostly folded leaflets (2) 4–12 (14) mm. long; *peduncles* erect or incurved-ascending, 3.5–9 cm. long, as long or commonly longer than the leaf; *racemes* densely, or in age somewhat loosely 15–37-flowered, the flowers early reflexed and retrorsely imbricated, the axis somewhat elongating, (1.5) 2–7 (8) cm. long in fruit; *bracts* membranous, triangular-ovate to linear-lanceolate, 1–3 mm. long; *pedicels* very early and strongly recurved, at anthesis 0.5–0.8 mm., in fruit a trifle thickened, 1.2–1.8 (2) mm. long, persistent; *bractoles* 2, minute; *calyx* 3.3–4.6 mm. long, strigulose with black or with mixed black and white hairs, the slightly oblique disc about 0.5 mm. deep, the campanulate tube 2–2.6 mm. long, 1.9–2.4 mm. in diameter, the subulate teeth 1–2.2 mm. long, either the dorsal one or the ventral pair the longest, the whole becoming papery, ruptured, marcescent; *petals* apparently purplish, the banner prominently purple-veined; *banner* abruptly recurved through about 80°, broadly or flabellately ovate-cuneate, deeply notched, 5.1–6.4 mm. long, 4.2–5.5 mm. wide; *wings* (about as long) 5–6.6 mm. long, the claws 2.2–2.6 mm., the oblong, obtuse or subemarginate, straight or gently (equally) incurved blades 3.4–4.5 mm. long, 1.5–2 mm. wide; *keel* 5–5.6 mm. long, the claws 2.3–2.7 mm., the half-obovate or nearly half-circular blades 2.7–3.5 mm. long, 2–2.2 mm. wide, incurved through 100° to the bluntly deltoid apex; *anthers* 0.4–0.5 mm. long; *pod* deflexed, sessile on the flat or slightly produced receptacle, plumply ovate-oblong to half-ovate-acuminate in profile, gently incurved or nearly straight, (5) 6–9 mm. long, 2.8–5 mm. in diameter, broadly rounded or subtruncate at base, abruptly contracted and cuspidate at apex, obscurely triquetrous, carinate ventrally by the prominent suture, a trifle depressed, flattened, or sometimes very shallowly and openly sulcate dorsally toward the base, the lateral angles broadly rounded, the thinly fleshy, green, strigulose or glabrescent valves becoming stiffly papery, stramineous or ultimately blackish, prominently reticulate, inflexed as a complete septum 1.8–2.7 mm. wide extending into apex of the beak; *dehiscence* through the length of both sutures and through the septum, the halves ultimately separating; *ovules* 8–14; *seeds* brown, soot-, or purplish-black, smooth, dull, 2–2.6 mm.

long.—Collections: 8 (o); representative: *Pringle 6404* (K, ND, NY, US), 9722 (K, NY, US); *Rose & Painter 7090* (NY, US); *Matuda 21,222* (MICH, NY).

Dry stony fields, grassy knolls, and open hillsides, often on limestone but probably also on volcanic bedrock, 6500–9300 feet, apparently not uncommon in the valley of Mexico (State and Federal District) and southern Hidalgo.—Map No. 155.—June to September.

ASTRAGALUS OXYRRHYNCHUS (sharp-beaked, of the pod) Hemsl., Biol. Centr.-Amer., Bot. 1: 265. 1880.—“South Mexico, Tizapan, valley of Mexico (Bourgeau 329)”; Diagn. Pl. Nov. Mex. 42. 1880.—“In convalli Mexici, *Bourgeau*.”—Holotypus, *Bourgeau 329*, collected June 18, 1865, K! isotypi, labeled “Pâturages à Zapan, près Mexico,” P, US!—*Tragacantha oxyrrhyncha* (Hemsl.) O. Kze., Rev. Gen. 947. 1891. *Hesperastragalus oxyrrhynchus* (Hemsl.) Rydb. in Bull. Torr. Club 53: 165. 1926.

Astragalus angelinus (of San Angel) Jones, Rev. Astrag. 286, Pl. 71. 1923 (“*Angelinus*”).—“From near San Angel valley of Mexico, J. N. Rose, Aug. 21, 1903. Nat. Herb. No. 450040 ...”—Holotypus (*Rose & Painter 6490*), US! isotypus, NY!

The sharp-beaked milk-vetch, *A. oxyrrhynchus*, differs from other *Micranthi* in its buried root-crown, dwarf stature, and pod of plumper outline not or only obscurely sulcate dorsally. The very small, abruptly reflexed flowers are typical of the section and the fruit differs only in its less pronounced trigonous compression. There is no reason to assume on the basis of this last feature that *A. oxyrrhynchus* is related to sect. *Didymocarpi* or the genus *Hesperastragalus*, of which the genuine members (= our sect. *Microlobium*) are Californian annuals with tiny, globose, two-seeded pods. The position of the root-crown and general habit of growth are likely to suggest some small-flowered *Strigulosi*, but these have the lower stipules connate and pods dehiscent on the raceme. Under *A. Hartwegi* I have suggested, however, that *A. oxyrrhynchus* may have originated as a recombination type following introgression between forebears of sects. *Strigulosi* and *Micranthi*. The species also resembles *A. hypoleucus* in many ways, the latter, however, being easily distinguished in practice by its sheathing stipules and dolabriform vesture.

The pod of *A. oxyrrhynchus* is somewhat variable in size and outline, but I agree with Rydberg that the specimens singled out by Jones as *A. angelinus* are variants of a minor, inconsequential nature. Jones (1923) referred *A. oxyrrhynchus* to sect. *Micranthi* and *A. angelinus* to sect. *Didymocarpi*, implying fundamental differences. However his figures of the fruits (Pl. 70, 71) depict that of *A. oxyrrhynchus* as semibilocular and deeply sulcate dorsally, and that of *A. angelinus* as more or less didymous; in reality the cross-section in both is ovate-triangular, little or not at all notched dorsally, and the septum in both is wide and complete. Rydberg (1926, l.c.) associated *Hesperastragalus oxyrrhynchus* with *H. reflexus*, a Texan annual which has similarly formed pods but differs greatly in shape and proportions of the petals, in vesture, and also in other respects; the relationship is exceedingly remote.

LXXXIV. Sectio HYPOLEUCI

Low perennials, with buried (rarely exposed) root-crown or caudex; *vesture* dolabriform, usually copious; *stipules* all connate; *leaves* imparipinnate, with 11–23 leaflets; *flowers* numerous, densely racemose, reflexed, very small, the banner $\pm$ 6–8 mm. long; *calyx-tube* campanulate; *petals* whitish $\pm$ purple-tinged or -veined, the banner and keel $\pm$ equal, the obtuse keel much shorter; *pod* reflexed, sessile, deciduous, narrowly oblong or lance-oblong, small ($\pm$ 7–12 mm. long), obtusely triquetrous, fully bilocular, the valves papery; *dehiscence* apical, after falling; *ovules* 6–14.—Sp. 1, xerophyte, of northeastern to southcentral Mexico.

ASTRAGALUS sect. HYPOLEUCI, sect. nov., pube dolabriformi, stipulis omnibus inter se concretis, floribus minimis leguminibusque parvulis bilocularibus trigonis refractis insignes. Inflorescentia fere sect. *Micranthorum* sed notulis aliis gravibus ab iis longe distantes; habitu *Strigulosos* parvifloros simulantes sed legumine deciduo, septoque completo absimiles; pube supra basin affixa ab omnibus *Astragalis* caeterius similibus cito diagnoscendi.—Sp. typica (unica): *A. hypoleucus* Schau.

Mention has been made already, in discussion of *A. Hartwegi*, of a complex situation encountered among some groups of small-flowered Mexican *Astragali*, which possess in various

combinations characters proper to the widely divergent emmenoloboid and piptoloboid phyla in the genus. The monotypic *Hypoleuci* is one of these groups, for it has an inflorescence and fruit quite similar to those of sect. *Micranthi* and of some small-flowered *Strigulosi*, with the latter's connate stipules and the former's disjointing pod. In general aspect *A. hypoleucus* is likely to recall *A. (Micranthi) oxyrrhynchus*, for both are low, slender plants with buried root-crowns and more or less developed subterranean caudices; but *A. hypoleucus* differs importantly in its sheathing stipules and is further specialized in the laterally attached vesture. There seems no alternative but to assign it to a section of its own.

344. ASTRAGALUS HYPOLEUCUS

Low, rather slender, perennial, with a woody taproot and ordinarily subterranean (more rarely, perhaps only accidentally, superficial) root-crown or shortly forking caudex, strigulose throughout with largely sinuous, but the leaflets with straighter, appressed mixed with a few longer and looser, spreading and ascending hairs up to 0.5–0.9 (1) mm. long, the herbage silvery or greenish-cinereous, the leaflets pubescent on both sides but sometimes more thinly so, exceptionally subglabrous above; *stems* several, diffuse and incurved-ascending, buried for a space of 0–15 cm., the aerial part 4–35 cm. long, simple or, when vigorous, few-branched near the base; *stipules* membranous early becoming papery-scarious, 1–5 (6.5) mm. long, the lowest smallest, all amplexicaul and connate through half their length or more into a sheath, this sometimes ruptured in age, densely pubescent dorsally; *leaves* 1–6 cm. long, all but the lowest subsessile, with (11) 13–23 crowded or moderately distant, elliptic, oblong-elliptic, or oblanceolate, acute, obtuse, or emarginate, flat or loosely folded, dorsally keeled leaflets 3–10 (12) mm. long; *peduncles* relatively stout, 2.5–9 cm. long, surpassing the leaf; *racemes* densely 10–30-flowered, sometimes becoming looser and interrupted in late anthesis, the axis more or less elongating, 1–5 (7) cm. long in fruit; *bracts* membranous, ovate-triangular or lanceolate, 0.8–2.5 mm. long; *pedicels* arched out- and downward, at anthesis 0.3–0.8 mm., in fruit thickened, 1–1.5 mm. long; *bracteoles* 0–2, but only rarely present and then minute; *calyx* 3.2–5.2 mm. long, strigulose with black or mixed black and white hairs, the sub-symmetric disc 0.5–0.9 mm. deep, the campanulate or turbinate-campanulate tube 2.2–3 mm. long, 1.7–2.4 mm. in diameter, the subulate or triangular-subulate teeth 0.8–2.5 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish tinged and veined with purple or dull lavender, rarely all bright purple, the wings about equaling the banner, the keel shortest; *banner* recurved through 50–100°, ovate-cuneate or rhombic-elliptic, notched, 6–8.2 mm. long, 3–4.3 mm. wide; *wings* (0.5 mm. longer to 1.2 mm. shorter than the banner) 6.1–8.7 mm. long, the claws 2–3 mm., the narrowly oblong-oblanceolate or -obovate, obtuse or obliquely emarginate blades 4.3–6.3 mm. long, 1.5–2.2 mm. wide, gently and equally incurved or the left one more abruptly so and further; *keel* 4.7–6.6 mm. long, the claws 2–3 mm., the half-obovate or nearly half-circular blades 2.7–4 mm. long, 1.6–2.2 mm. wide, abruptly incurved through 95–105° to the obtusely or sharply deltoid apex; *anthers* 0.3–0.45 mm. long; *pod* deflexed, sessile on an incipient gynophore up to 0.3–0.5 mm. long, narrowly oblong or lance-oblong in profile, straight or gently incurved, 7–12 mm. long, (2) 2.3–4 mm. in diameter, rounded at base, abruptly contracted distally into a short, erect or slightly declined cusp, obtusely triquetrous, bluntly carinate ventrally by the suture, grooved dorsally, the thinly fleshy valves densely strigulose-hirsutulous or simply strigulose with white or mixed black and white hairs, becoming stiffly papery, inflexed as a complete septum 0.9–1.4 mm. wide; *seeds* brown or olivaceous, sometimes purple-dotted, smooth but scarcely lustrous, 1.3–1.9 mm. long.—Collections: 29 (iii): representative: *Pringle* 9721 (NY, US), 6366 (CAS, G, ND, NY, US), 9648 (MICH, US); *Amable & Arsène* 2020 (CAS, NY); *C. & M. Mueller* 549 (MICH,

TEX); *Waterfall 13,930* (RSA); *Ripley & Barneby 13,343* (CAS, MICH, NY, RSA, US).

Savannahs, stony plains, gullied badlands, hot, rocky hillsides with *Cactaceae* and thorn scrub, ascending into open pine and oak forest, about 6000–8000 feet, commonly on limestone (or gypsum) but also on volcanic and metamorphic bed-rock, widespread and locally plentiful, southwestern Tamaulipas and central Nuevo León to Jalisco and Oaxaca.—Map No. 155.—April to October, apparently flowering with equal vigor after spring and summer rains.

ASTRAGALUS HYPOLEUCUS (whitish, or white beneath) Schau. in *Linnaea* 20: 747. 1847.—“In montanis Mexici, loco non notato, *Aschenborn no. 343*.”—No typus examined, but the full description decisive.—*Tragacantha hypoleuca* (Schau.) O. Kze., *Rev. Gen.* 945. 1891. *Hamosa hypoleuca* (Schau.) Rydb. in *Bull. Torr. Club* 54: 334. 1927.

Astragalus luisanus (of San Luis Tultitlanapa) Jones, *Rev. Astrag.* 275, Pl. 69. 1923.—“The types are Purpus plants Nos. 3208 from near Oaxaca and 2477 from Esperanza in the state of Puebla . . .”—Holotypus (collected at San Luis Tultitlanapa near Oaxaca, in August 1908), POM! isotypi, MO, NY, US! paratypi (from Esperanza), GH, MO, NY, POM, UC, US!

The *Aschenborn* milk-vetch, *A. hypoleucus*, is the only Mexican *Astragalus* other than *A. humistratus*, which extends only feebly south into Sonora and Chihuahua, characterized by dolabriform pubescence and connate stipules. While the two species are alike in their diffuse stems and commonly ashen foliage, they are dissimilar in detail, the flowers of *A. humistratus* being much larger and differently shaped, and its pod humistrate, ascending, and unilocular. In practice *A. hypoleucus* could be confused only with some slender *Micranthi*, particularly with *A. oxyrrhynchus*, but these have basifix hairs and all stipules free.

Variation in *A. hypoleucus* is sometimes striking but of a superficial nature, not more pronounced than should be expected of a species dispersed along the Cordillera through nearly nine degrees of latitude. The leaflets are commonly gray on both sides, rarely glabrescent medially or truly glabrous above. In the raceme the hairs vary from black, the commonest color, to nearly all white, and on the pod from white to white mixed with black or fuscous in a pepper-and-salt combination. The pod is somewhat unstable as to length, diameter, and curvature, these minor deviations from an arbitrarily assumed standard corresponding with no discernible pattern of dispersal. The typus of *A. luisanus* which, according to Jones's key, should differ from genuine *A. hypoleucus* and *A. Hartwegi* in its few-flowered spikes, is in no respect exceptional.

LXXXV. Sectio CHAETODONTES

Caulescent (rarely subcaulescent) perennials, with superficial or (in *A. sepultipes*) subterranean root-crown or caudex; *vesture* basifix, usually loose and copious; *leaves* imparipinnate, with 7–25, dorsally carinate leaflets; *flowers* racemose, subcapitate, or subspicate, loosely ascending, spreading, or early declined, variable in size, the banner $\pm$ 5–17.5 mm. long; *pedicels* subpersistent or readily disjuncting; *calyx-tube* campanulate or obconic-campanulate, sometimes accrescent and investing the fruit; *petals* whitish, pinkish- or grayish-lavender, or pale yellow, regularly but sometimes only a little graduated, the banner recurved through 35–85°, the keel-tip obtuse; *pod* widely spreading or declined, sessile or nearly so, readily or tardily disjuncting, either ovoid and obscurely triquetrous, or oblong and compressed-triquetrous, depressed or sulcate dorsally (the groove sometimes almost closed), fully bilocular, the valves stiffly papery; *ovules* 4–20.—Spp. 9, xerophytes (except *A. Lemmoni*), of the Columbia Basin, the lower Snake River Plains, the northern Great Basin west to the east slope and crest of the Sierra Nevada, eastern Washington to southcentral Idaho and northeastern and eastcentral California.

The *Chaetodontes* form a somewhat heterogeneous group of species built up by accretion around a nucleus of *A. Lyalli* and *A. caricinus*, a pair of species characterized by tiny, loosely racemose flowers and small but exserted, compressed-trigonal pods. The two species are so much alike they have been confused in the past; however they differ in many small details, most

importantly in the stipules, in the first free, in the second connate into a scarious sheath. The passage in one direction from *A. Lyalli* into the free-stipuled *A. Spaldingii* (and its close ally *A. tyghensis*), in which the flowers are densely spicate and the equally small, less strongly compressed pod remains partly invested by the accrescent calyx, is a considerable but comprehensible step. In the opposite direction we pass from *A. caricinus* into *A. Andersonii*, a species similar in foliage and stipules but larger-flowered and bearing a much longer, even though similarly formed fruit. The montane *A. Austinae* seems to have been derived from *A. Andersonii* by condensation. The flowers and leaves remain almost unaltered, but the plant has become densely tufted or pulvinate, the racemes have become subcapitate, and the pod has become so short as to mimic that of *A. Spaldingii* in what is clearly an example of convergent evolution. In *A. sepultipes*, a second derivative of *A. Andersonii*, the flowers and pods have increased a little in size, while the root-crown has receded below ground, the feature to which the species owes its name and individuality of aspect. The *Chaetodontes* that have been mentioned up to this point have been arranged in four subsections characterized by stipular, floral, and carpological features; common to all are the copious vesture of loose, often partly twisted hairs and leaflets mostly sessile (i.e., lacking a visible petiolule), acute or subacute, keeled dorsally by the midrib, and inclined to disjoint from the leaf-stalk as the tissues of the plant dry out in summer or in press. To these has been added, with some reluctance, the remarkable little *A. Lemmoni*, resembling *A. caricinus*, *A. Lyalli*, and especially *A. lentiformis* (with which tradition associates it) in its tiny flowers and pods, differing in its free stipules and thinly strigulose, green herbage. It is distinguished from other *Chaetodontes* by its mode of branching, the lower branchlets being paired with a peduncle (representing an axillary branchlet of the third order) while the upper inflorescences are disposed in pairs or threes. In its specialized habitat on banks of streams and rushy lake shores *A. Lemmoni* is unique in the section.

A notable feature of sect. *Chaetodontes* is the duplication of certain unusual morphological characters in pairs of species not immediately related. The small pod partly included in the calyx common to *A. (Andersoniani) Austinae* and *A. (Chaetodontes) Spaldingii* has already been mentioned. More immediately striking are the pubescent petals of *A. Austinae* and *A. (Chaetodontes) tyghensis*. In *A. (Andersoniani) Andersonii* and *A. (Lentiformes) caricinus* the first two or three internodes of the stems, which are separated by scarious, glabrescent, stipular sheaths, are much more densely tomentulose than the rest. These seem to be instances of orthogenetic modifications following the same (as it were foreordained) course along parallel evolutionary lines. They also provide evidence of the naturalness of sect. *Chaetodontes* which would lend itself to fragmentation if treated on a strictly technical basis.

The section was erected by Gray to accommodate only *A. Lyalli* and *A. Spaldingii*, first known as *A. chaetodon* Torr. It was enlarged by Jones (1923, p. 172) to include *A. Austinae* and the giant cismontane *A. Brauntonii*, now transferred to a section of its own. Rydberg (1929, pp. 452-3) accepted the species known to him as genuine *Astragali* and dispersed them among two sections: the *Chaetodontes*, characterized by densely racemose-subspicate inflorescence and ascending fruits, and the *Lentiformes*, characterized by lax racemes and nodding fruits. Neither scheme provided a place among its kindred for *A. Andersonii* which was associated by Jones (1923, p. 260) with the emmenoloboid, free-stipuled *A. (Miselli) Congdoni* and by Rydberg with the similarly characterized *Hamosa* sect. *Malaci* (our sect. *Malaci*).

Key to the Subsections of Sect. *Chaetodontes*

1. Stipules all free, even the lowest embracing no more than $\frac{3}{4}$ the stem's circumference; Washington, n. Oregon, and e.-centr. Idaho (the mesophytic *A. Lemmoni* s. to e. California). Pod small, 3.5-8 mm. long (2)
2. Pubescence of the herbage dense, villousulous or tomentulose; *peduncles* all solitary in the axils; xerophytes, of Washington, n. transmontane Oregon, and Idaho (3)
3. Racemes spiciform, ovoid or cylindroid at early anthesis, elongating and sometimes interrupted in fruit but the pods spreading-ascending on obconic pedicels 0.3-1 mm. long; *peduncles* 3-12 cm. long, nearly always equaling or surpassing the leaf; *calyx-tube* plumply campanulate or urceolate, (2.5) 3-4.5 mm. long, somewhat accrescent and (2.4) 2.6-4.1 mm. in diameter, investing the whole or $\frac{3}{4}$ the pod LXXXV (i). Subsect. *Chaetodontes*
3. Racemes loosely flowered from early anthesis, in fruit open and secund, the sub-filiform pedicels then 0.8-1.8 mm. long; *peduncles* 1.5-6.5 cm. long, shorter than the leaf; *calyx-tube* narrowly campanulate or turbinate, 1.6-2.7 mm. long, 1.8-2.6 mm. in diameter, not accrescent, investing no more than half (usually less) of the pod LXXXV (ii). Subsect. *Lyalliani*
2. Pubescence of the herbage sparse, appressed, the leaves green; *peduncles* geminate or (proximally) paired with a branchlet; mesophytes ranging along the base of the Sierra and Cascades from the upper Deschutes River in Oregon to e.-centr.

- California LXXXV (iii). Subsect. *Lemmoniani*
1. Stipules all, or at least those at the lowest nodes, connate; California to s. Idaho and adjacent Oregon, 1 sp. extending interruptedly into e. Washington. Pods either large or small (4)
 4. Pods very small, 5–8.5 mm. long; *flowers* very small, loosely racemose, the banner 4.5–7 mm., the keel 4–5 mm. long; *petals* glabrous LXXXV. (iv). Subsect. *Lentiformes*
 4. Pods over 1 cm. long, or if shorter then the petals silky-pubescent dorsally and the racemes subcapitate; *flowers* larger, the banner 8.5–17.5 mm., the keel 6.2–12.2 mm. long LXXXV (v). Subsect. *Andersoniani*

LXXXV (i). Subsectio CHAETODONTES

Stipules free; *racemes* spiciform, narrowly ovoid-oblong or cylindric in fruit, the pods spreading-ascending on obconic pedicels; *flowers* small, the banner 7–12 mm. long; *pod* small, ovoid and only obscurely trigonous, invested for at least $\frac{3}{4}$ its length by the somewhat accrescent, ovoid-urceolate calyx, tardily (if at all) disjoining from the receptacle, deciduous together with the pedicel and calyx.—Spp. 2, of the Columbia Basin.

ASTRAGALUS sect. CHAETODONTES Gray in Proc. Amer. Acad. 6: 194. 1864, sens. strict.—Sp. typica: *A. chaetodon* Torr., non Bge. = *A. Spaldingii* Gray.

Astragalus sect. *Spaldingiani* Rydb., Fl. Rocky Mts. 493, in clave. 1906.—Sp. unica: *A. Spaldingii* Gray.

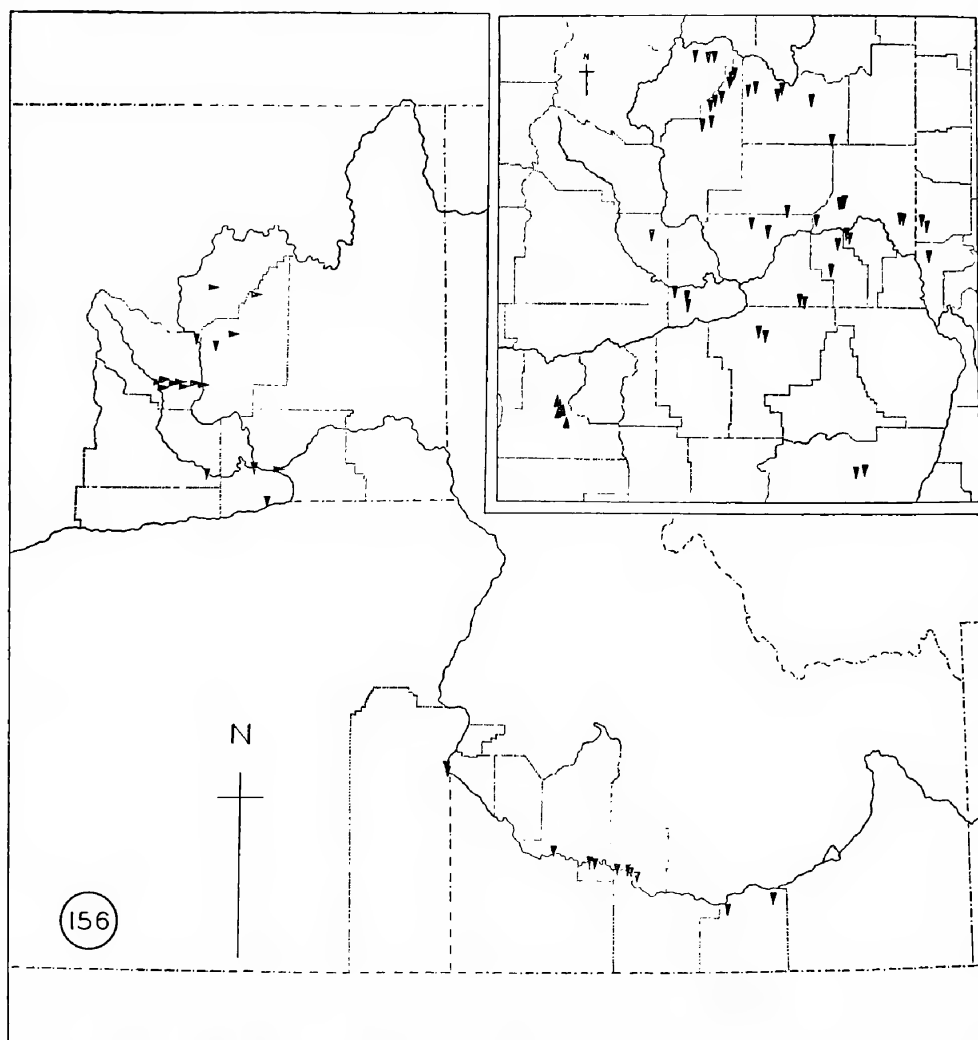
Key to the Species of Subsect. Chaetodontes

1. Petals whitish tinged with lilac, glabrous dorsally; *leaflets* thin-textured, gray-villous; e. Washington, Blue Mountains of n.-e. Oregon, and w.-centr. Idaho 345. *A. Spaldingii*
1. Petals pale yellow, all dorsally pubescent distally; *leaflets* appearing thick-textured from the dense gray-tomentose vesture; local in Wasco County, Oregon 346. *A. tyghensis*

345. ASTRAGALUS SPALDINGII

Diffuse, rather slender, with a shortly forking or at length knotty caudex, villous throughout with fine, sinuous, $\pm$ entangled, together with longer, almost straight, widely spreading or ascending hairs up to 1–1.7 (2) mm. long, the herbage gray or canescent, the calyces more densely villous or villous-tomentose, the inflorescence commonly white-silky; *stems* numerous, prostrate or decumbent with ascending tips, (0.5) 1–3.5 (4) dm. long, together forming low tufts or loosely woven mats, all simple, or shortly spurred (rarely branched) at 1–3 nodes preceding the first peduncle; *stipules* thinly herbaceous becoming papery-membranous, lanceolate or lance-acuminate or -caudate, 2.5–7 mm. long, decurrent around half or less of the stem's circumference; *leaves* 2.5–10 cm. long, the lower ones slender-petioled, the upper shortly so or sessile, with (9) 15–25 (29) narrowly elliptic to elliptic-oblancheolate and acute, occasionally (in some or all leaves) oblong-obovate to oblanceolate and obtuse or obtuse and mucronulate, flat or loosely folded, often scattered leaflets 4–16 mm. long; *peduncles* erect or incurved-ascending, 3–10 cm. long, subpaniculately disposed in the distal axils; *racemes* (6) 12–30 (35)-flowered, the spreading flowers at early anthesis crowded into an ovoid or oblong head, the axis $\pm$ elongating, (1) 1.5–5 (7) cm. long in fruit, the fruiting raceme narrowly oblong-cylindric, often interrupted toward the base; *bracts* herbaceous becoming membranous, linear or linear-setaceous, 1.5–4.5 mm. long; *pedicels* at anthesis obconic, 0.2–0.4 mm. long, in fruit 0.3–0.8 mm. long; *bracteoles* 0; *calyx* (5) 5.6–8.3 mm. long, white-, or the teeth partly black-villous, the subsymmetric disc 0.4–0.8 (1) mm. deep, the submembranous, ovoid-campanulate tube (2.5) 3.1–4.5 mm. long, (2.4) 2.6–3.6 mm. in diameter, the narrowly subulate, often incurved, herbaceous teeth 2–4.2 mm. long, the whole

becoming papery-membranous, marcescent, ruptured or not; *petals* whitish or sordid, often tinged (or the banner veined) with grayish-lavender, commonly marcescent about the forming fruit; *banner* recurved through $\pm 50^\circ$, ovate-cuneate, 7–11 (11.7) mm. long, 4.3–6.2 mm. wide; *wings* 6.2–9.2 (9.8) mm. long, the claws 2.7–4 mm., the obliquely elliptic or narrowly obovate, rarely lance-elliptic, obtuse, subacute, or obscurely emarginate, gently incurved blades (3.8) 4.1–6.2 mm. long, 1.5–2.6 mm. wide, the left one usually concave and folded over the keel; *keel* 5.2–7.4 mm. long, the claws 2.5–3.7 (4.4) mm., the half-circular or -obovate blades 2.2–3.2 (3.8) mm. long, 1.6–2.2 mm. wide, abruptly incurved through $95\text{--}120^\circ$ to the obtuse, sometimes obscurely porrect apex; *anthers* 0.3–0.5 (0.6) mm. long; *pod* horizontally spreading or widely ascending, sessile or elevated on a minute neck up to 0.3 mm. long, subsistent on the receptacle, the body obliquely ovoid, (3.5) 4–6 mm. long, 2.5–3.5 mm. in diameter, abruptly cuspidate at apex, laterally compressed with plumply distended and convex lat-



Map No. 156. Left, transmontane Oregon and Washington, and southern Idaho. Range of $\blacklozenge$ *A. Lyalli*; and of $\blacktriangledown$ *A. caricinus*. Top right, parts of transmontane Oregon and Washington. Range of $\blacksquare$ *A. Spaldingii*; and of $\blacktriangle$ *A. tyghensis*.

eral faces, keeled ventrally by the prominent, thick suture, shallowly sulcate dorsally but the groove open only near the base or sometimes subobsolete, the stiffly papery, densely villous-tomentulose valves inflexed as a complete septum produced into the pod's apex; *dehiscence* tardy, after falling; *ovules* 4–8, rarely 9–10; *seeds* olivaceous, sometimes purple-speckled, smooth and sublustrous, 1.8–2.6 mm. long.—Collections: 54 (iv); representative: *H. T. Rogers* 668 (CAS, NY, WS, WTU); *J. W. Thompson* 11,663 (CAS, NY, WTU); *Ripley & Barneby* 10,773 (CAS, NY, RSA, WTU); *Cronquist* 6508 (ID, NY, SMU, TEX, WS); *Cusick* 1701 (ND, WS).

Dry hillsides, valley floors, in bunchgrass prairies and sagebrush scabland, commonly in sandy or sandy loam soils derived from basalt, 1000–2600, rarely up to 3900 feet, widespread and rather common in transmontane Washington, from Grand Coulee south and east to the lower Yakima River, the lower Umatilla Valley in northeastern Oregon, and the Clearwater Valley in eastcentral Idaho; apparently somewhat isolated on the upper Powder River in central Baker County, Oregon.—Map No. 156.—May to July.

ASTRAGALUS SPALDINGII (Henry Harmon Spalding, 1804–1874, missionary and founder of Lapwai Mission near the mouth of the Clearwater River; his collections are believed to have been made by Mrs. Spalding) Gray in Proc. Amer. Acad. 6: 524. 1865, a substitute for *A. chaetodon* (with bristlelike calyx-teeth) Torr. ex Gray in op. cit. 6: 194. 1864 (non *A. chaetodon* Bge., 1851).—"Plains on the Kooskooskie River, interior of Washington Territory, Rev. Mr. Spalding, Dr. Pickering."—Holotypus, labeled "*A. chaetodon* Torr. ined. Kooskooskee. Mr. Spalding," NY! isotypi, GH, PH!—*Tragacantha Spaldingii* (Gray) O. Kze., Rev. Gen. 948. 1891. *Phaca Spaldingii* (Gray) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 370. 1906.

The Spalding milk-vetch is easily recognized by its ovoid or finally oblong-cylindric, spike-like racemes of small, crowded, pallid flowers which give rise to tiny, densely pubescent, ovoid pods invested for at least three fourths and often their whole length by the somewhat accrescent calyx. As the fruit reaches maturity, the pedicels disjoint readily, and the calyx, marcescent petals, and pod fall together to the ground. Small and light, they are quickly carried away by the wind and may sometimes be found piled up in miniature windrows under tufts of grass or among the twigs of desert shrubs. Dehiscence is delayed until after falling, and it is uncertain how the seeds are finally released, or even whether the pod itself disjoints naturally from the receptacle as in other members of the section. Enclosed and supported as it is by the enveloping calyx, the pod can hardly be subjected to the mechanical stresses which are responsible for the fracture of the joint in most piptoloboid astragali.

The plants of the Spalding milk-vetch are often browsed and are said to provide good forage, being eaten greedily by stock and horses (*Pickett* 537, WS).

346. *ASTRAGALUS TYCHENSIS*

Similar to *A. Spaldingii* but of more robust growth, with a thick, woody taproot and shortly forking, knotty caudex, densely villous-tomentose throughout with extremely fine, curly and entangled together with straighter, loosely ascending and spreading hairs up to 1–1.5 mm. long, the stems and herbage somewhat silky in youth, becoming gray-cottony in age, the vesture of the inflorescence turning cream-color when dry; *stems* several or numerous, (1) 1.5–5.5 dm. long, simple except for an occasional spur in some lower axils, prostrate or weakly ascending, forming loose mats or low, tufted clumps; *stipules* membranous or early becoming so, lanceolate or lance-acuminate, 3–6 mm. long, semiamplexicaul-decurrent; *leaves* 5–14 cm. long, the uppermost sessile, with (7) 15–21 oval-obovate, obtuse or subacute, or (in some upper leaves) elliptic and acute, flat leaflets 6–17 mm. long, the blades thin-textured, but appearing thick from the matted vesture; *peduncles* subcorymbosely disposed in the upper axils, erect or incurved-ascending, 5–12 cm. long; *racemes* (10) 20–40-flowered, the flowers crowded at anthesis into a dense, ovoid or oblong head, this elongating into a narrowly cylindric spike, often somewhat interrupted at base, the axis (2.5) 4–12

cm. long in fruit; *bracts* linear or linear-lanceolate, 2–5 mm. long, scarious-margined, ultimately reflexed; *pedicels* at anthesis subobsolete, in fruit obconic, 0.5–1 mm. long; *bracteoles* 0; *calyx* densely silky-villous, at anthesis 6.6–7.8 mm. long, the slightly oblique, saucer-shaped disc 0.8–1 mm. deep, the broadly campanulate, membranous tube 3.9–4.5 mm. long, 3.5–4.1 mm. in diameter, the narrowly subulate, herbaceous teeth 2.7–3.5 mm. long, the whole somewhat accrescent, the tube becoming ovoid, tumid, papery, ruptured or not, but with the connivent teeth enclosing the small pod; *petals* pale yellow, all pubescent dorsally above the middle, marcescent; *banner* recurved through $\pm 50^\circ$, spatulate, 9–12 mm. long, the obscurely notched blade 5–8 mm. wide; *wings* 8.3–10.3 mm. long, the claws 4.2–5 mm., the obliquely elliptic, obtuse, $\pm$ incurved blades 5–6.4 mm. long, 2.1–2.6 mm. wide; *keel* 7.1–8.2 mm. long, the claws 4–5 mm., the half-circular blades 3.3–3.6 mm. long, 2–2.3 mm. wide, abruptly incurved through $100\text{--}120^\circ$ to the obtusely deltoid apex; *anthers* 0.5–0.6 mm. long; *pod* horizontal or a trifle declined, abruptly contracted at base into an obliquely attached stipelike neck 0.4–0.6 mm. long (but this apparently disjointing in age), the body obliquely ovoid, 4.5–6 mm. long, 3 mm. in diameter, shortly cuspidate at apex, obscurely trigonous, bluntly keeled ventrally by the thick, prominent, nearly straight suture, the dorsal face impressed as a short, open groove or rounded depression below the middle, the lateral faces plumply convex, the stiffly papery, canescently tomentulose valves inflexed as a complete or subcomplete septum ± 2 mm. wide produced into the pod's apex; *dehiscence* unknown; *ovules* (6) 8; *seeds* (fully formed but unripe) $\pm 2.1\text{--}2.5$ mm. long.—Collections: 11 (ii); representative: *Peck 26,171* (CAS, RSA), *26,246* (RSA, WILLU, WS); *Ripley & Barneby 10,826* (CAS, NY, RSA, WILLU, WTU); *J. W. Thompson 4956* (MO, WILLU, WTU); *C. L. Hitchcock 20,741* (NY).

Dry hillsides and valley floors, in sandy clay soils overlying basalt, commonly among sagebrush, 1500–1800 feet, locally plentiful but known only from the east foothills of the Cascade Range on the lower White and adjoining Deschutes Rivers in Wasco County, Oregon.—Map No. 156.—May to July.

ASTRAGALUS TYGHENSIS (of Tygh Valley) Peck in Proc. Biol. Soc. Wash. 49: 110. 1936.—“dry slope near Tygh Valley, Wasco County, Oregon, *Peck 17367*.”—Holotypus, collected May 29, 1933, WILLU! isotypus, RSA!—*A. Spaldingii* var. *tyghensis* (Peck) C. L. Hitchc. in Univ. Wash. Pub. Biol. 17: 262. 1961.

The Tygh Valley milk-vetch was first collected as early as 1894 by Francis E. Lloyd (NY), but the specimens were passed over by Rydberg and others as representing a robust form of *A. Spaldingii*. The two species are close kindred and there is some reason to evaluate *A. tyghensis* as no more than a strongly marked variety or geographic subspecies of its common relative; however, the differences, closely observed, are several and striking, especially in the field. The individual plant of *A. tyghensis* is (at least on the average) stouter, with more numerous flowered and longer fruiting racemes, and the pannose vesture is thicker, softer, and more intricately tangled. The fresh petals of *A. tyghensis* are distinctly yellow, pale but clear; those of *A. Spaldingii*, although they turn stramineous when dry, are at first white or dirty white, often suffused with grayish-lavender. Furthermore, the minute but definite stipe in *A. tyghensis* is attached so obliquely as to form almost a right angle with the base of the pod-body, and not (as in *A. Spaldingii* where, if at all developed, it remains extremely short and obscure) in a plane perpendicular to the body. The pubescent petals of the Tygh Valley milk-vetch are immediately noteworthy and furnish the most easily observed diagnostic character.

The known range of *A. tyghensis* extends from a point a few miles south of the village of Maupin northward in a narrow strip across the valley of the White River as far as the south slope of Tygh Grade, a distance of some fifteen or possibly twenty miles. The species is locally abundant, forming large colonies, and shows little variation. The nearest established station for *A. Spaldingii* lies about one hundred miles distant to the northeast, in the Rattlesnake Hills of Benton County, Washington.

LXXXV (ii). Subsectio LYALLIANI

Stipules free; *racemes* loose (or early becoming so), the flowers at late anthesis and the fruits declined and secund; *flowers* very small, the banner 5.3–8 mm. long; *pod* declined, small, ellipsoid, laterally compressed-triquetrous, subpersistent, well exerted from the calyx, tardily falling with the disjointing pedicel.—Sp. 1, of the Columbia Basin.

ASTRAGALUS sect. CHAETODONTES subsect. LYALLIANI, subsect. nov., inter *Chaetodontes* veros et *Lentiformes* quasi intermedii, illis stipulis liberis similes sed racemo laxo secundo et calyce haud accrescenti dispares, ab his vix nisi stipulis inter se liberis nec concretis vaginantibus sejungendi.—Sp. unica: *A. Lyalli* Gray.

347. ASTRAGALUS LYALLI

Diffuse, rather slender, with a woody taproot and at length knotty caudex, densely gray-villous throughout with extremely fine, sinuous, together with some longer, almost straight, spreading and ascending hairs up to 1–1.8 mm. long, the inflorescence commonly at least in part black- or fuscous-pubescent; *stems* several or numerous, decumbent and weakly ascending, (1) 1.5–4 dm. long, simple except for an occasional spur in some lower axils, but occasionally bearing a reduced peduncle, or a leaf and peduncle together (representing a suppressed branchlet) in the axil of a primary raceme; *stipules* thinly herbaceous becoming membranous, 3–8 mm. long, the lowest mostly ovate, the upper ones lanceolate or lance-acuminate, decurrent around $\frac{3}{4}$ or the uppermost around less than $\frac{1}{2}$ the stem's circumference, with ascending or spreading blades; *leaves* (3) 4–11 cm. long, the lowest petioled, the rest very shortly so or subsessile, with 11–19 mostly elliptic, linear-elliptic, or oblanceolate and acute, rarely oval and mucronate or shortly acuminate, flat or loosely folded leaflets 6–16 mm. long; *peduncles* numerous, the first often arising at or below the middle of the stem, erect or narrowly ascending, 1.5–6.5 cm. long, shorter than the leaf; *racemes* loosely (7) 10–21-flowered, the flowers early spreading and declined, the axis (2) 3.5–9 (11) cm. long in fruit; *bracts* subherbaceous or membranous, linear or setaceous, 1.5–4.5 mm. long; *pedicels* at anthesis 0.5–1 mm. long, in fruit slender, spreading or arched downward, 0.8–1.8 mm. long; *bracteoles* 0 (rarely a minute scale); *calyx* 3.8–5.6 mm. long, densely villous, the subsymmetric disc 0.2–0.6 mm. deep, the campanulate or turbinate-campanulate tube 1.6–2.5 (2.7) mm. long, 1.8–2.6 mm. in diameter, the setaceous, often curved teeth 1.7–3.4 mm. long, the whole becoming papery-membranous, ruptured, marcescent around the proximal $\frac{1}{3}$ or $\frac{1}{2}$ of the pod; *petals* whitish tinged with dull lavender, the banner striate; *banner* recurved through $\pm 50^\circ$, ovate-cuneate, rather deeply notched, 5.3–7.4 (8) mm. long, 3.5–4.6 (5) mm. wide; *wings* 5.1–7 mm. long, the claws 1.6–2.4 mm., the obliquely elliptic-obovate, obtuse or emarginate, strongly incurved blades 3.6–5 mm. long, 1.5–2.4 mm. wide; *keel* 3.8–4.9 mm. long, the claws 1.7–2.6 mm., the lunately half-circular blades 2.1–2.8 mm. long, 1.4–1.9 mm. wide; *anthers* 0.3–0.4 (0.45) mm. long; *pod* declined or deflexed, subsessile, the minute, glabrous, necklike stipe (0.1) 0.3–0.5 mm. long, the body subsymmetrically ellipsoid or ovoid-ellipsoid, 5–8 mm. long, (2) 2.5–3.5 mm. in diameter, cuneate at both ends, or rounded at base and cuspidate at apex, laterally and subtrigonously compressed, with low-convex lateral faces, carinate ventrally by the prominent suture, narrowly sulcate dorsally (the groove often closed), the papery, finely reticulate, villous-tomentulose valves inflexed as a complete or commonly incomplete septum 0.8–1.4 mm. wide; *dehiscence* tardy, after falling; *ovules* 4–8; *seeds* pale brown or olivaceous, sometimes purple-speckled, smooth but scarcely lustrous, 2.1–2.9 mm. long.—Collections:

19 (i); representative: *C. L. Hitchcock* 17,456 (ID, NY, RSA, WS); *Piper* 2683 (NY, WS); *J. W. Thompson* 11,620 (CAS, NY, WS, WTU), 13,703 (CAS, NY, WS, WTU); *Ripley & Barneby* 10,862 (CAS, RSA, WTU).

Low hills and rolling plains, in sandy or loamy soils derived from basalt, often among and taking shelter under sagebrush, 600–2200 feet, locally abundant in the Yakima and Columbia Valleys in Kittitas County, Washington, extending more rarely northeast to the Grand Coulee region in Douglas County and south to the mouth of the Snake River in Franklin County.—Map No. 156.—May to early July.

ASTRAGALUS LYALLI (David Lyall, 1817–1895, surgeon and botanist to the Canadian Boundary Survey, 1858–1861) Gray in Proc. Amer. Acad. 6: 195. 1864.—“Upper Yakima River, on the boundary between British Columbia and Washington Territory, Dr. Lyall (no. 8, ex herb. Kew.).—“Holotypus, collected in 1860, GH! isotypus, K!—*Tragacantha Lyalli* (Gray) O. Kze., Rev. Gen. 946. 1891. *Phaca Lyalli* (Gray) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 370. 1906.

The Lyall milk-vetch is intermediate in several respects between *A. Spaldingii* of the preceding subsection and *A. caricinus* of subsect. *Lentiformes*, leaning toward the former in its diffuse growth-habit and free stipules and toward the latter in its loosely racemose, nodding flowers and declined, exerted pod. Although recognizable at a glance once its critical features are appreciated, *A. Lyalli* has often been confused with *A. caricinus*; the following contrasts may forestall difficulties in the future:

- | | |
|---|---------------------|
| 1. Stipules all free, semiamplexicaul-decurrent; stems weakly diffuse, equally pubescent their whole length, not more densely pubescent at base than distally; peduncles numerous, the stems floriferous upward from near the middle; pod minutely stipitate | <i>A. Lyalli</i> |
| 1. Stipules connate, the lower ones into a scarious, bidentate sheath, the upper ones united at base only or rarely free; stems stiffly erect and ascending in clumps, the lowest 2–4, abbreviated internodes densely white-tomentose; peduncles stiffly erect from the 2–5 uppermost leaf-axils; pod exactly sessile | <i>A. caricinus</i> |

The Lyall milk-vetch is a critical species, one of great theoretical interest. It seems quite closely related both to *A. caricinus* and to *A. Spaldingii*, yet these two astragali are different in many important features and are not closely related to each other, despite their common kinship with *A. Lyalli*. The origin of this curious situation is illumined by study of the dispersal patterns of the three species, as shown in the accompanying maps. It is established that *A. Spaldingii* is generally dispersed over the lower Columbia Basin southward from Grand Coulee except for a puzzling gap which extends over the south half of Grant and southeastern Kittitas Counties. This gap seems inexplicable in terms of probability, for there are no apparent physiographic or edaphic barriers to exclude the species. Remarkably enough, it is precisely into this gap that one can fit the main range of *A. Lyalli*, a species abundant in southeastern Kittitas County but known to extend north toward Grand Coulee only sporadically and south only to one station at the mouth of the Snake River. The picture is now complicated by the curious bicentric dispersal of *A. caricinus*. This species is most abundant along the banks of the Snake River in southwestern Idaho, reappearing in two restricted areas in eastern Washington, one near Quincy in southern Grant County, the other on and near the Rattlesnake Hills within the loop formed by the Great Bend of the Columbia. It is reasonable to interpret these outposts of *A. caricinus*, separated from the principal area of abundance by at least two hundred miles of mountainous terrain impassable to migration except by way of the Snake River canyon, as colonial settlements originating from water-borne seed. In Idaho *A. caricinus* is found on bluffs overlooking the Snake River, where every opportunity is offered for this type of seed dispersal. If such was the course of events, and *A. caricinus* became established in riparian habitats along the lower Columbia, it was invading the range of a related but morphologically dissimilar species, *A. Spaldingii*; and the stage was fortuitously set for potential introgression between the two. It seems likely that *A. Lyalli* represents the progeny of hybridization fixed through generations of selection; and that, having effectively replaced the pure parent strains in Kittitas County (although these still exist independently elsewhere in the Columbia Basin), it is now making some small migratory advance north and southward into the range of *A. Spaldingii*. The hypothesis has the merit of bringing into coherent focus three striking facts: the illogical absence of *A. Spaldingii* from Kittitas County; the bicentric dispersal of *A. caricinus*; and the morphological intermediacy of *A. Lyalli*.

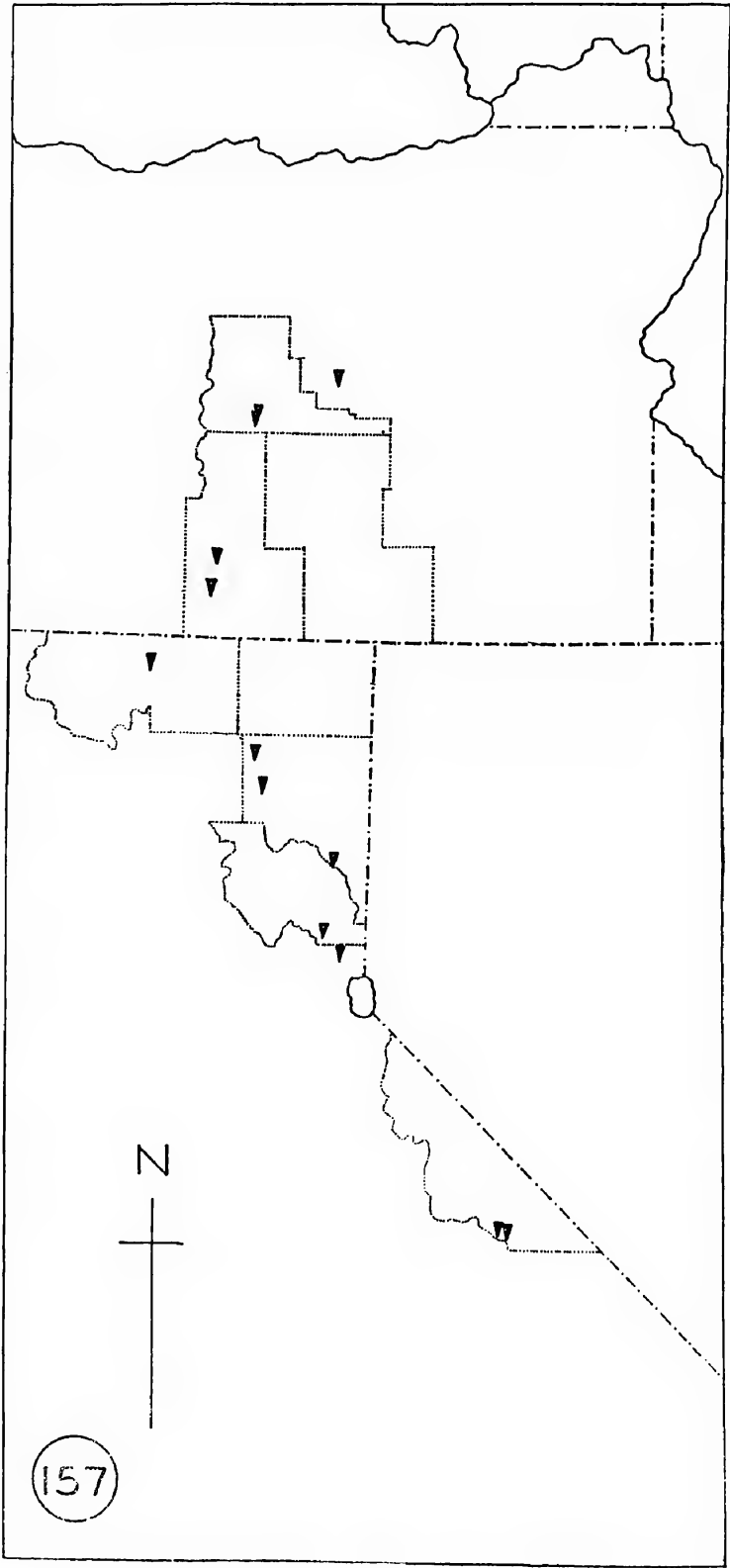
LXXXV (iii). Subsectio LEMMONIANI

Stipules free; *racemes* (borne in unequal pairs in the upper axils) loosely but very shortly few-flowered, the flowers loosely ascending, very small, the banner about 5–6 mm. long; *pedicels* slender but persistent with the calyx after the pod has fallen; *pod* very small, but well exerted from the calyx, elliptic or oblong-elliptic in profile, compressed-triquetrous, dehiscent primarily at base and upward through both sutures and the septum.—Sp. 1, mesophyte, of the west edge of the Great Basin, central Oregon to eastcentral California.

ASTRAGALUS sect. CHAETODONTES subsect. LEMMONIANI, subsect. nov., a *Lyallianis* quoad stipulas inter se liberis similibus racemo perbrevis paucifloro et legumine e calyce marcescenti deciduo, a *Lentiformibus* stipulis liberis nec connatis, ab ambabus pube tenui appressa habituque mesophilo diversi. Herbae delicatulae prostratae pedunculis (ut rarius apud *A. Lyalli*) binis ternisque in axillis superioribus dispositis insignes.—Sp. unica: *A. Lemmoni* Gray.

348. ASTRAGALUS LEMMONI

Delicately slender, diffuse, with a stout, woody taproot and at length knotty root-crown or shortly forking caudex, sparsely strigulose with fine, straight, appressed or some narrowly ascending hairs up to 0.25–0.5 mm. long, the stems sometimes glabrous, the herbage green, the leaflets glabrous or nearly so above; *stems* several or numerous, prostrately radiating, 1–4 (5) dm. long, simple or sparingly branched at base, thereafter bearing a peduncle or a peduncle and spur together in each axis, floriferous upward nearly its whole length, the spurs upward reduced to a single peduncle (or two) and the racemes then disposed in unequal pairs (or threes); *stipules* submembranous becoming pallid and scarious, ovate- or triangular-lanceolate, 2–5 mm. long, decurrent around half or nearly the whole stem's circumference, free; *leaves* (1) 1.5–4.5 cm. long, all or at least the lowest petioled, the uppermost commonly subsessile, with (7) 9–15 narrowly elliptic or elliptic-oblancoate, acute or subacute, rarely truncate-emarginate, flat or loosely folded leaflets 2–11 mm. long; *peduncles* slender, ascending, 6–17 mm. long, much shorter than the leaves; *racemes* loosely but shortly (2) 5–13-flowered, the flowers loosely ascending, the axis scarcely elongating, 2–10 mm. long in fruit; *bracts* membranous, ovate or lance-ovate, 0.8–2 mm. long; *pedicels* subfiliform, at anthesis ascending, 0.7–2 mm. long, in fruit arched outward, 0.9–2.5 mm. long, scarcely thickened, but the fertile ones persistent; *bracteoles* 0; *calyx* 3–3.9 mm. long, strigulose with white or sometimes a few black hairs, the symmetric disc 0.3–0.6 mm. deep, the campanulate tube 1.7–2.2 mm. long, 1.4–1.8 mm. in diameter, the subulate teeth 1.1–1.7 mm. long, the whole becoming papery, ruptured, persistent; *petals* whitish or tinged with lilac, the banner sometimes dull purple-veined; *banner* recurved through 45–85°, rhombic-obovate or broadly rhombic-oblancoate, 4.8–6.1 mm. long, 2.8–4.5 mm. wide; *wings* 4.4–5.9 mm. long, the claws 1.5–1.9 mm., the oblong-elliptic, obtuse, strongly incurved blades 3.1–4.6 mm. long, 1.4–1.9 mm. wide; *keel* 3.4–4 mm. long, the claws 1.4–1.8 mm., the asymmetrically half-circular blades 2–2.7 mm. long, 1.3–1.5 mm. wide, abruptly incurved through about 135° to the triangular, obtuse, somewhat porrect apex; *anthers* 0.3–0.4 mm. long; *pod* spreading or a trifle declined, sessile, elliptic or oblong-elliptic in profile, straight or a trifle incurved, 4–7 mm. long, 1.5–2.5 mm. in diameter, obtuse at base, abruptly triangular-acute at apex, compressed-triquetrous with nearly flat lateral and narrower, sulcate dorsal faces, carinate ventrally by the suture, the lateral angles obtuse, the thin, pale green, strigulose valves becoming papery, stramineous or brownish, faintly cross-reticulate, inflexed as a complete or nearly complete septum 0.8–1.3 mm. wide; *ovules* 4–8; *seeds* chestnut-brown, smooth but dull, 1.2–1.6 mm. long.—Collections: 18



(o); representative: *Maguire & Holmgren* 26,472 (NY, RSA, TEX, WS); *Eastwood & Howell* 7962 (CAS); *Eastwood* 7791 (CAS, POM, UC); *Lemmon* 50, 72 (MO, NY); *Peirson* 10,744 (RSA).

Forming colonies in moist, but often summer-dry meadows and rushy flats along stream and lake shores, 4200–5200 feet, scattered and not common, along the east foothills of the Cascade Range and Sierra Nevada and plains immediately adjoining, from near the head of the Deschutes River in central Oregon south to Sierra Valley, California, and western Washoe County, Nevada; apparently isolated, at 6700–7000 feet, on upper Owens River, Mono County, California.—Map No. 157.—Late May to August.

ASTRAGALUS LEMMONI (John Gill Lemmon, 1832–1908, pioneer botanical collector in the n. Sierra Nevada in the 1870's) Gray in Proc. Amer. Acad. 8: 627. 1873.—“Sierra Valley, Sierra County, California, J. G. Lemmon, communicated by Dr. Bolander.”—Holotypus, collected in June, 1872, GH! The spm. at NY dated May 10, 1872, is perhaps an isotypus.—*Tragacantha Lemmoni* (Gray) O. Kze., Rev. Gen. 946. 1891.

The Lemmon milk-vetch is a rare little astragalus, remarkable morphologically for its racemes of tiny flowers borne on short peduncles in pairs or fascicles of three at all nodes above the last lateral branch, and physiologically for its adaptation to moist alkaline habitats on the banks of streams or the shores of Basin lakes. It was associated by Jones (1923, p. 276) with some small-flowered members of the largely Mexican sect. *Strigulosi*. Technical characters of free stipules and deciduous pod suffice to exclude *A. Lemmoni* from the *Strigulosi*, although the imponderable differences of growth-habit are equally decisive. Rydberg (1929, p. 453) transferred the species to his sect. *Lentiformes* in company with *A. Lyalli* and *A. lentiformis*. These are characterized by equally small flowers and fruits of similar size and structure, but are quite diverse in other respects. The Lemmon milk-vetch resembles *A. Lyalli* in its free stipules but differs in its short, few-flowered racemes and pod deciduous from the persistent pedicel and calyx; *A. lentiformis*, with similar inflorescence, has connate stipules and pedicels disjoining in age. From the *Chaetodontes* as a whole *A. Lemmoni* stands apart because of its thin, appressed vesture and mesophytic habitat, but it is probably a highly specialized member of the group.

LXXXV (iv). Subsectio LENTIFORMES

Stipules connate, the uppermost ones sometimes shortly so or free; *racemes* loose, the flowers at late anthesis and the fruits declined or deflexed; *flowers* very small, the banner 4.5–7 mm. long; *pod* small, lance-ellipsoid or lenticular, compressed-triquetrous, sulcate or flattened dorsally, exserted from the calyx, deciduous with the pedicel and sometimes tardily disjoining from the receptacle.—Spp. 2, of northeastern California, southwestern Idaho and adjoining Oregon, and interior Washington.

ASTRAGALUS sect. **CHAETODONTES** subsect. **LENTIFORMES** (Rydb.), stat. nov., based on *Astragalus* sect. *Lentiformes* Rydb. in N. Amer. Fl. 24: 452. 1929, pro parte; Rydb. in Bull. Torr. Club 56: 553. 1930.

Key to the Species of Subsect. Lentiformes

1. Stems erect and ascending in clumps, (1) 1.5–3 dm. long, more densely tomentose at very base than distally; *leaves* 3.5–10.5 cm. long, with 11–23 leaflets (3) 5–18 mm. long; *racemes* (5) 10–25-flowered, the fruiting axis (1.5) 3–10.5 cm. long; s. Idaho to e. Washington 349. *A. caricinus*
1. Stems diffuse, 1–1.8 dm. long, not tomentose at base; *leaves* 1–3.5 cm. long, with 7–15 leaflets 2–10 mm. long; *racemes* 5–10-flowered, the fruiting axis not over 1.6 cm. long; n.-e. California 350. *A. lentiformis*

349. ASTRAGALUS CARICINUS

Slender, but stiff and wiry, with a woody taproot and at length knotty caudex, densely gray-pubescent throughout, the herbage villous with mixed sinuous and

straighter ascending hairs up to 1–1.3 mm. long, the stems subappressed-pilose, the lowest 3–4 abbreviated internodes white-tomentose; *stems* numerous, erect and ascending, (1) 1.5–3 dm. long, simple or bearing a few subbasal spurs and an occasional branchlet from the axil next below the first peduncle; *stipules* (2) 3–8 mm. long, early becoming pallid and scarious, the lowest and median ones connate through half their length or more into a tightly amplexicaul (sometimes tardily ruptured) sheath, the upper ones progressively less connate, the uppermost sometimes united by a stipular line or free; *leaves* 3.5–9 (10.5) cm. long, petioled or the uppermost subsessile, with stiff rachis and 11–19 (23) narrowly elliptic, lance-elliptic, or narrowly oblong, sharply acute, or in some leaves oval, subobtusate or merely mucronulate, flat or loosely folded, at length deciduous leaflets (3) 5–15 (18) mm. long; *peduncles* erect from the 3–5 upper axils, 0.5–5 (7) cm. long, mostly much shorter than the leaf; *racemes* loosely (5) 10–25-flowered, the flowers at first ascending, early spreading and then declined, the fruiting axis (1.5) 3–10.5 cm. long; *bracts* submembranous, subulate or setaceous, 1–2.5 mm. long; *pedicels* at anthesis mostly obconic and 0.4–0.9 mm. long, in fruit divaricate or recurved, 0.6–1.3 (1.5) mm. long, tardily disjointing; *bracteoles* 0; *calyx* 3.5–5.5 mm. long, densely villous-villosulous with white or mixed black and white hairs, the subsymmetric disc 0.2–0.5 mm. deep, the obconic-campanulate tube 2–2.5 (2.8) mm. long, 1.7–2.2 mm. in diameter, the subulate-setaceous teeth (1.3) 1.5–3 mm. long; *petals* whitish tinged with grayish-lavender, yellowish when dry, commonly marcescent; *banner* recurved through $\pm 50^\circ$ flabellate-obcordate or broadly obovate-cuneate, 4.5–6 (7) mm. long, 3.4–5.2 mm. wide; *wings* 4.5–6.1 mm. long, the claws (1.4) 1.7–2.2 mm., the obliquely obovate, obtuse, strongly incurved blades 3–4.3 mm. long, (1.3) 1.8–2.1 mm. wide, the left one concave and folded over the keel; *keel* (3.6) 4–5 mm. long, the claws (1.6) 1.8–2.3 mm., the half-circular blades 2.3–2.8 mm. long, 1.4–1.8 mm. wide, abruptly incurved through $110\text{--}130^\circ$ to the bluntly deltoid, sometimes obscurely porrect apex; *anthers* 0.3–0.45 mm. long; *pod* reflexed, sessile, tardily disjointing (after falling), subsymmetrically lance-ellipsoid or ellipsoid, 6–8.5 mm. long, 2–2.7 (3) mm. in diameter, rounded or cuneate at base, gradually contracted distally and cuspidate at apex, somewhat laterally and triquetrously compressed, with flat or low-concave lateral faces, keeled ventrally by the prominent suture, narrowly sulcate dorsally (the groove sometimes almost closed), the papery, finely reticulate, canescently tomentulose valves inflexed as a complete or nearly complete septum 0.6–1.3 mm. wide produced into the pod's apex; *dehiscence* not seen; *ovules* 6–8; *seeds* olivaceous, purple-speckled, smooth but dull, 2.3–2.8 mm. long.—Collections: 22 (i); representative: *Maguire & Holmgren* 26,252, 26,259 (NY, RSA, WS); *Peck* 25,928 (CAS, RSA, WILLU, WS); *Nelson & Macbride* 1713 (ID, NY, RM, WTU); *Ripley & Barneby* 6471 (CAS, NY, RSA); *Cronquist* 6583 (ID, NY, OKLA, SMU, TEX, WS).

Gullied bluffs, barren hillsides, and fallow fields, commonly in sandy soil or on wind-blown dunes derived from basalt substrata, occasionally on shaley clays or stiff loams, locally plentiful, 2400–4300 feet, along the Snake River and immediate tributaries from the lower Raft River in Cassia County, Idaho, downstream to northern Owyhee County and extending just into eastern Malheur County, Oregon; also disjunctly, at 700–1250 feet, along the Columbia and lower Yakima Rivers in Benton, Grant, and Yakima Counties, Washington.—Map No. 156.—May to July.

ASTRAGALUS CARICINUS (Jones) Barneby in Amer. Midl. Nat. 55: 502. 1956, based on *A. Lyalli* var. *caricinus* (sedgelike, the pod likened to a "buckwheat or *Carex* grain") Jones, Rev.

Astrag. 174, Pl. 41. 1923.—“... on sand dunes at Glenn's Ferry, Idaho.”—Holotypus, collected June 17, 1911, by M. E. Jones, POM! isotypi, CAS, NY!

Along the Snake River in Idaho the buckwheat milk-vetch, *A. caricinus*, is easily recognized by its gray-villosulous herbage and basally tomentose stems combined with tiny, loosely racemose flowers and small, reflexed, bilocular pods. One must be careful in eastern Washington to distinguish the superficially similar *A. Lyalli*, under the heading of which the differential characters and other matters of interest concerning *A. caricinus* are discussed.

The earliest-known collection of *A. caricinus* dates back to the Northwestern Expedition of 1883 (*Canby*, or possibly *Brandegee*, 717, GH). It was one of many interesting plants from the Columbia Valley which Canby distributed under the vague label of “Walla Walla region.” According to this label the plants were eaten greedily by stock.

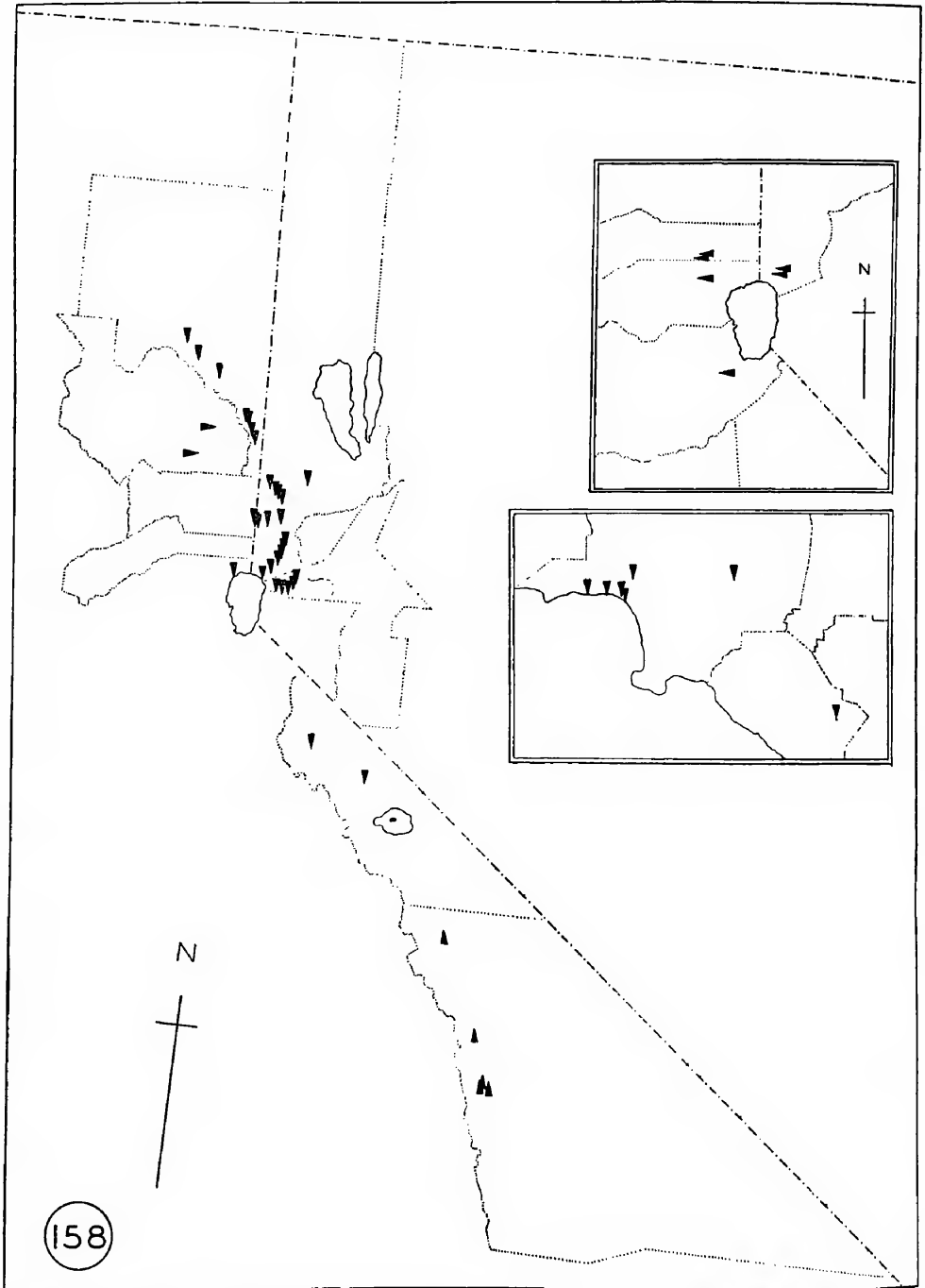
350. ASTRAGALUS LENTIFORMIS

Low, slender, with a thick, woody taproot and shortly forking, suffruticulose caudex, gray-villosulous with fine, spreading, partly sinuous or twisted hairs up to 0.5–1 mm. long, the stramineous stems thinly so, the herbage greenish-cinereous, the leaflets glabrescent above; *stems* many, diffuse, simple above the immediate base, 9–18 cm. long; *stipules* up to 7 mm. long, the lowest membranous, pallid, strongly adnate and also connate into a loose, bidentate sheath, the upper ones firmer or herbaceous, broadly lanceolate to linear-acuminate, semi- or almost fully amplexicaul, free; *leaves* 1.2–3.5 cm. long, the uppermost shortly petioled or subsessile, with 7–15 oblanceolate, narrowly obovate, or elliptic, obtuse or subacute, dorsally keeled, loosely folded leaflets 2–10 mm. long; *peduncles* slender, incurved-ascending, 4–16 mm. long, shorter than the leaf; *racemes* shortly but loosely 5–10-flowered, the flowers early declined, the axis 4–16 mm. long in fruit; *bracts* membranous or membranous-margined, linear or linear-lanceolate, 1.5–3 mm. long; *pedicels* slender, 1–1.8 mm. long, in fruit little elongated or thickened, recurved or reflexed, tardily disjointing; *bracteoles* 0; *calyx* 3.6–4.5 mm. long, white-villosulous, the slightly oblique disc 0.5–0.6 mm. deep, the tube 2.2–2.9 mm. long, ± 2 mm. in diameter, the subulate teeth 1.3–2.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* at first ivory-yellow, drying deeper yellow, the banner faintly brown-veined when dry; *banner* recurved through $\pm 50^\circ$, ovate-cuneate, notched, 6.2–7 mm. long, 3.8–4.5 mm. wide; *wings* 6–6.6 mm. long, the claws 2.2–2.6 mm., the lance-elliptic blades 4–4.2 mm. long, 1.5–1.7 mm. wide, both incurved but the left one more abruptly so and infolded over the keel; *keel* 4–4.9 mm. long, the claws 2–2.5 mm., the half-circular blades 2.3–2.5 mm. long, 1.4–1.7 mm. wide, abruptly incurved through 130° to the deltoid, obscurely porrect apex; *anthers* 0.3–0.4 mm. long; *pod* declined, sessile, tardily deciduous, symmetrically or subsymmetrically oblong-lenticular in profile, 5–8.5 mm. long, 2.5–3 mm. in diameter, rounded at base, contracted at apex into a subulate cusp ± 1 mm. long, laterally compressed-triquetrous, with almost flat lateral faces much broader than the depressed but scarcely sulcate dorsal one, carinate ventrally by the prominent but slender suture, the thin, pale green valves villosulous with ascending or incurved-ascending hairs, becoming stramineous, papery, reticulate, inflexed as a complete septum 1.5–2 mm. wide; *dehiscence* apical, basal, and through the ventral suture; *ovules* 6–10; *seeds* brown, smooth, somewhat lustrous, ± 2 mm. long.—Collections: 6 (o); representative: *Lemmon* 50 (G, NY), 73 (CAS, MO, NY); *Eastwood* 7021 (CAS, UC, US); *J. T. Howell* 37,702 (NY).

Dry sandy soil among sagebrush, sometimes with Jeffrey pine, 4800–5100 feet, rare and local, known only from Sierra and Clover Valleys, at the east foot of the northern Sierra Nevada, in Plumas and Sierra Counties, California.—Map No. 158.—May to July.

ASTRAGALUS LENTIFORMIS (lentil-shaped, of the pod) Gray ap. Brew. & Wats., Bot. Calif.

156. 1876.—“Sierra Nevada, in Clover Valley, &c., on the borders of California and N.W. Nevada, Lemmon.”—Holotypus, *Lemmon* 537 in 1874, GH! isotypus, UC!—*Tragacantha lentiformis* (Gray) O. Kze., Rev. Gen. 946. 1891.



Map No. 158. Left, northwestern Nevada and parts of California. Range of ▼ *A. Andersonii*; of ▲ *A. sepultipes*; and of ◆ *A. lentiformis*. Inset, top right, the Lake Tahoe region of the Sierra Nevada. Range of ▲ *A. Austinae*. Inset, bottom right, parts of Los Angeles and Orange Counties, southern California. Range of ▲ *A. Brauntonii*.

The lentil milk-vetch is an inconspicuous plant, notable principally for its rarity and for the small size of all its parts. Only two other astragali with flowers as small are known to occur in the Sierra Valley region; both are easily distinguished from *A. lentiformis*, the related *A. Lemmoni* by its appressed vestiture, free stipules, and paired peduncles, and the apparently more distantly akin even though habitually similar *A. Pulsiferae* by its inflated, unilocular fruit. The combination in the lentil milk-vetch of the growth-habit and pubescence of *A. Pulsiferae* var. *Suksdorfii* with the pod, scarcely altered, of *A. Lemmoni*, suggests that the species may have arisen through hybridization between these sympatric, even though ecologically disparate, small-flowered astragali.

Specimens of *A. lentiformis* were distributed by Lemmon under at least four serial numbers, without indication of exact locality, so that I cannot tell whether he collected it in more than two stations, the Clover and Sierra Valleys of the original description. It was rediscovered by Alice Eastwood near Portola in Plumas County and collected in the same place as lately as 1962 by John Thomas Howell. The colony discovered by Mr. Howell consisted of only three plants.

LXXXV (v). Subsectio ANDERSONIANI

Strongly caulescent or subcaulescent; *stipules* all, or at least those at the lower nodes, connate; *flowers* racemose or subumbellate, of moderate size, the banner 8.5–17.5 mm. long; *pod* spreading, declined, or ascending, readily deciduous, either lance-oblong in profile and long-exserted, or shortly ovoid-oblong and invested by the calyx, compressed-triquetrous.—Spp. 3, of the east foothills, east slope and crest of the Sierra Nevada from Lassen south to Inyo County, California, and immediately adjoining Nevada.

ASTRAGALUS sect. CHAETODONTES subsect. ANDERSONIANI, subsect. nov., vix nisi floribus majusculis (vexillo 8.5–17.5 mm. longo) a *Lentiformibus* sejungendi.

Key to the Species of Subsect. Andersoniani

1. *Petals* glabrous; *pod* 1–2 cm. long, well exserted from the calyx; *stems* mostly 1–3.5 dm. long; *racemes* (10) 12–30-flowered, 2–11 cm. long in fruit; *ovules* 10–20; plants of the foothills and lower slopes, below 7500 ft. (2)
2. *Stems* arising from a superficial root-crown, the short, lowest internodes emerged and densely white-tomentose; *calyx* 6.2–8.2 mm. long; *keel* 6.6–9 mm. long; *ovules* 10–16; Mono County, California, n. through w. Nevada to Lassen County, California 351. *A. Andersonii*
2. *Stems* arising from a buried root-crown, their bases subterranean and glabrous for a space of 0.5–5.5 cm.; *calyx* 8.6–13 mm. long; *keel* 10–12.2 mm. long; *ovules* (14) 16–20; local in Inyo County, California 352. *A. sepultipes*
1. *Petals* silky-pubescent dorsally; *pod* 5.5–7 mm. long, included in the calyx or nearly so; *stems* mostly less than 1 dm. long, often subobsolete; *racemes* subcapitately 4–15-flowered, the axis not over 1.5 cm. long in fruit; *ovules* 5–8; plants of the higher Sierra Nevada, near and above timber line, mostly over 9000 ft., Nevada to Eldorado County, California, and Mt. Rose, Nevada 353. *A. Austinae*

351. ASTRAGALUS ANDERSONII

Low, loosely tufted, with a woody taproot and shortly forking caudex, densely gray-villous throughout with fine, shorter and sinuous together with longer, almost straight, spreading or widely ascending hairs up to 1–1.3 mm. long, the stems more densely and shortly white-tomentose at base than distally; *stems* several or numerous, decumbent and incurved-ascending, (0.7) 1–2 dm. long, simple or bearing 1 spur or branchlet from a subbasal axil, commonly zigzag distally in age; *stipules* (1.5) 2–7 mm. long, the lowest early becoming scarious, amplexicaul and connate through half their length or less into a sheath (sometimes ruptured by the expanding stem), the upper ones connate at base only, or united by a stipular line, or free, with lanceolate or triangular, erect, usually herbaceous blades; *leaves* (2) 3–10 cm. long, the lower ones petioled, the upper shortly so or sessile, with (9) 13–21 mostly elliptic-oblancoate and acute or abruptly short-acuminate, more rarely oval-obovate and mucronulate or obtuse, flat or loosely folded leaflets 3–10

(14) mm. long; *peduncles* erect or incurved-ascending, (2) 3–7 cm. long, either slightly longer or shorter than the leaf; *racemes* 12–20 (26)-flowered, rather dense at early anthesis, the flowers at first ascending, finally declined, the axis early elongating, 2.5–8 cm. long in fruit; *bracts* thinly herbaceous becoming scarious, narrowly lanceolate to linear-setaceous, 2–4 mm. long; *pedicels* at anthesis straight, ascending, 0.6–1 mm. long, in fruit usually arched outward, 1–1.7 mm. long, finally disjoining; *bracteoles* 0; *calyx* 6.2–8.2 mm. long, densely curly-villous, the subsymmetric disc 0.7–1 mm. deep, the campanulate tube 3.5–4.3 mm. long, 2.7–3.6 mm. in diameter, the subulate or subsetaceous teeth 2.4–4.3 mm. long, the whole becoming papery, ruptured, marcescent; *petals* whitish or ochroleucous, often tinged, and the banner veined, with dull lavender; *banner* recurved through $\pm 45^\circ$, ovate- or obovate-cuneate, 9.5–14.5 mm. long, 6.1–8 mm. wide; *wings* 8.8–13.5 mm. long, the claws 3.2–5 mm., the lunately oblong-elliptic, obtuse blades 6–9.5 mm. long, 2.2–3 mm. wide; *keel* 6.6–9 mm. long, the claws 3.2–4.8 mm., the half-obovate blades 3.6–4.8 mm. long, 2.2–2.9 mm. wide, abruptly incurved through $90\text{--}95^\circ$ to the bluntly deltoid apex; *anthers* 0.45–0.55 mm. long; *pod* horizontally spreading or declined, sessile on a minute bosslike gynophore up to 0.5 mm. long, readily deciduous, the body obliquely oblong, linear-oblong, or narrowly lanceolate in profile, gently incurved or falcate, (1) 1.2–1.8 cm. long, 3–4.5 mm. in diameter, rounded at base, abruptly acute or sometimes tapering distally, cuspidate, strongly compressed-triquetrous, with low-convex or nearly flat lateral faces and shallowly sulcate dorsal face, carinate ventrally by the prominent suture, the thin, pale green, villous or villous-tomentulose valves becoming papery, stramineous, finely reticulate, inflexed as a complete or nearly complete septum 1.8–3 mm. wide; *dehiscence* primarily basal, after falling, ultimately through the ventral suture and the beak, the base of the valves curling back to release the seeds; *ovules* (10) 12–16; *seeds* brown or olivaceous, often purple-speckled, smooth or sparsely pitted, 1.9–2.8 (3.1) mm. long.—Collections: 50 (vi); representative: *M. & G. Ownbey* 2925 (CAS, NY, RSA, SMU, WS); *Train* 3612 (NA, NY); *Ripley & Barneby* 4461, 5821 (CAS, RSA).

Sandy flats, gravelly hillsides, and valley floors, in light dry soils overlying granites or more rarely basalt, 4300–7200 feet, locally plentiful in a narrow strip along the east base of the Sierra Nevada from Mono Lake, Mono County, California, north to the lower Carson and Truckee Valleys in western Nevada, reentering California in southern Lassen County.—Map No. 158.—April to June, or July at the greatest elevations.

ASTRAGALUS ANDERSONII (Charles Lewis Anderson, 1827–1910) Gray in Proc. Amer. Acad. 6: 524. 1864.—“Near Carson City, Nevada, Dr. C. L. Anderson (1863 and 1864).”—Cotypi, collected in 1863 and 1864, GH! isotypi (1864), MO, NY, P, US!—*Tragacantha Andersonii* (Gray) O. Kze., Rev. Gen. 943. 1891. *Hamosa Andersonii* (Gray) Rydb. in Bull. Torr. Club 54: 16. 1927.

In southern Washoe and Ormsby Counties, Nevada, the Anderson milk-vetch is a common and rather conspicuous element of the spring flora, easily distinguished from other astragali of the region by its connate stipules, gray-villous leaves, whitish or faintly lavender-tinged flowers, and declined, gently incurved, compressed-triquetrous pods which disjoin readily when ripe and dehisce by a somewhat elastic basal fracture on the ground. It is especially common between 4500 and 5500 feet around the east base of Mt. Rose and in the Truckee Valley upstream from Reno and extends northwest from there in a narrow belt, closely following the outer fringes of the Sierran pine forest, as far as Honey Lake. No record of its occurrence in Douglas or Lyon Counties has been seen and the stations in Mono County, where *A. Andersonii* reaches up to the 7000 feet contour and is decidedly rare, appear somewhat isolated. The Anderson milk-vetch is normally part of the sagebrush climax flora but is quick to colonize cleared and subsequently abandoned land, flourishing on grassy road embankments and in fallow fields. The species apparently affords a wholesome forage, for plants browsed down to the crown are often seen.

352. *ASTRAGALUS SEPULTIPES*

Moderately stout or quite slender, with a woody taproot and knotty, shortly forking, subterranean caudex, strigulose-villosulous and villous-pilose with shorter, subappressed, together with longer, loosely ascending, somewhat wavy hairs up to 0.85–1.15 mm. long, the stems greenish, the herbage silvery- or cinereous-silky, the inflorescence densely villous; *stems* several 1.5–3.5 dm. long, slender, glabrous, buried for a space of 0.5–5.5 cm., thereafter either simple or branched at 1–2 nodes preceding the first peduncle, diffuse and ascending, flexuous or zigzag distally; *stipules* (2) 3–7.5 cm. long, the lowest ones small, connate through $\pm$ half their length into a pallid, scarious, glabrous sheath, the median and upper ones herbaceous above the base, amplexicaul and connate by a narrow scarious collar, with triangular-acuminate, spreading, dorsally pubescent blades; *leaves* divaricate and ascending, 2–8 cm. long, mostly shorter than the principal internodes, shortly petioled or the uppermost subsessile, with (7) 11–17 obovate-cuneate or broadly oblanceolate, retuse, or truncate and mucronulate, usually loosely folded leaflets (3) 4–14 mm. long; *peduncles* rather stout, incurved-ascending, (3) 5–12.5 cm. long, surpassing the leaf; *racemes* (10) 15–30-flowered, rather dense and ovate-oblong in early anthesis, looser in age, the flowers subhorizontal or ascending at a wide angle, the axis (2) 4–11 cm. long in fruit; *bracts* herbaceous, lanceolate or sublinear, 3–5 mm. long; *pedicels* at anthesis slender, ascending, 0.8–1.5 mm. long, somewhat thickened but hardly elongating in fruit, finally disjoining; *bracteoles* 0–2, minute when present and concealed by the vesture; *calyx* 8.6–13 mm. long, densely villous-villosulous with lustrous white hairs, the subsymmetric disc 1.1–1.6 mm. deep, the submembranous, purplish tube (4.7) 5.1–6.5 mm. long, 3.6–4.2 mm. in diameter, the linear-caudate, plumose-ciliate teeth 3.5–5.7 (6.5) mm. long, the whole becoming papery, ruptured, marcescent; *petals* pinkish-white, or pale lilac with whitish wing-tips; *banner* recurved through $\pm 40^\circ$, rhombically ovate-cuneate, notched, (12.7) 14.5–17.5 mm. long, 8.8–10.8 mm. wide; *wings* (11.1) 12–14 mm. long, the claws 4.8–6.6 mm., the straight, oblong, obliquely truncate or emarginate blades 7.2–8.8 mm. long, (2.2) 2.7–3.6 mm. wide; *keel* (10) 10.3–12.2 mm. long, the claws 4.8–7.2 mm., the lunately half-obovate blades 5.5–6.3 mm. long, 2.7–3.4 mm. wide, incurved through 90–95° to the rounded apex; *anthers* (0.6) 0.7–0.95 mm. long; *pod* loosely spreading-ascending or declined, sessile, deciduous, narrowly oblong in profile, gently incurved, 1.5–2 cm. long, 3.5–5.5 mm. in diameter, cuneate at both ends, cuspidate at apex, compressed-triquetrous, carinate ventrally by the suture, with almost flat lateral and narrower, shallowly sulcate dorsal faces, the thinly fleshy, finely twisted-villous valves becoming stiffly papery, stramineous, reticulate, inflexed as a complete septum 2–3.5 mm. wide; *dehiscence* apparently apical, perhaps also tardily basal; *ovules* (14) 16–20; *seeds* not seen.—Collections: 9 (i); representative: *Alexander & Kellogg* 2819 (DS, NY, US, UTC, WS); *Barneby* 11,327 (CAS, NY, RSA); *L. S. Rose* 58,070 (CAS).

Dry benches and canyon banks, in granite sand, among sagebrush in piñon forest, local but forming colonies at 6000–6500 feet in the east foothills of the Sierra Nevada from near Lone Pine north to Independence Creek, Inyo County, California.—Map No. 158.—May to July.

ASTRAGALUS SEPULTIPES (Barneby) Barneby in *Aliso* 4: 136. 1958, based on *A. Andersonii* var. *sepultipes* (with buried foot, of the subterranean caudex) Barneby in *El Aliso* 2: 209. 1950.—“CALIFORNIA: foothills west of Bishop, Inyo Co. . . . 21 May, 1906 . . . *A. A. Heller* 8357 . . .”—Holotypus, CAS! isotypi, G, NY, P, US!

The Bishop milk-vetch, *A. sepultipes*, was described as a variety of *A. Andersonii*, but as now known from much more ample material it may be recognized by strong technical char-

acters. The buried root-crown, silken rather than stiffly villous herbage, firm stipules and bracts, larger flowers, and more numerous ovules distinguish it from its relative at all stages of growth. The average plant is more slender and graceful than *A. Andersonii*, because of the greater development of the internodes, most of which surpass the leaves in length. The position of the resting buds below ground, in the context of the section evidently a specialized feature, is characteristic and constant, whether the plants are found on steep banks or on level ground, and cannot be attributed to accidental burial by shifting talus. Fully ripe fruits are still required to show the mode of fall and dehiscence, but there is little reason to anticipate anything original in these respects.

Although the flowers are relatively large, the Bishop milk-vetch is not one of the showy astragali. The petals are whitish faintly tinged with pink, or dull gray-lavender which appears almost truly gray in the strong desert light; the silvery-silky pubescence of the leaves makes an attractive contrast with the villous inflorescence. The plants have a quite individual grace. The species was first collected in 1897 by Marcus E. Jones (POM, UTC) near Lone Pine.

353. ASTRAGALUS AUSTINAE

Dwarf, densely tufted, matted, or almost pulvinate, shortly caulescent or subacaulescent, with a thick, ultimately gnarled and tortuous, woody taproot and repeatedly forking, suffrutescent caudex beset with a thatch of persistent leaf-bases, densely silvery-villous or -villosulous and often at the same time tomentulose with fine, lustrous, loosely ascending (commonly mixed with shorter, sinuous or curly hairs up to 0.65–1.3 mm. long; *stems* of the year almost 0 up to 11 cm. long, the internodes either all concealed by imbricated stipules or 1 or more of them developed and up to 1–2.5 (3.8) cm. long; *stipules* scarious, pallid, prominently nerved, 2–6.5 mm. long, all amplexicaul and connate through half to nearly their whole length into a tightly or loosely appressed sheath; *leaves* (0.7) 1–4 (5) cm. long, with short, thick petioles and (5) 7–13 ("17") crowded, elliptic or oblanceolate, acute or subobtuse, sessile but jointed, dorsally keeled and folded leaflets 1.5–9 mm. long; *peduncles* erect or ascending, or the outer ones prostrate and radiating, 1–4 (5) cm. long; *racemes* subumbellately 4–15-flowered, the erect and ascending flowers crowded into a dense, ovoid or subglobose head, the axis scarcely elongating, 2–10 (15) mm. long in fruit; *bracts* broadly scarious-margined, linear-lanceolate, involute, 3–5.5 mm. long; *pedicels* narrowly turbinate, 0.4–0.8 mm. long, ultimately disjointing with calyx and pod; *bracteoles* 0; *calyx* (6.6) 7–9.3 mm. long, densely villous-hirsute with white, rarely mixed with a few black hairs, the membranous, campanulate or ovoid-campanulate tube 3.3–5.3 mm. long, 2.6–3.5 mm. in diameter, the firm, narrowly subulate, commonly incurved teeth 2.9–4.6 mm. long, the whole becoming papery, a trifle tumid or inflated, marcescent around the fruit; *petals* whitish tinged, or the banner veined, with dull lilac, the blades of the banner and wings silvery-villosulous dorsally; *banner* gently recurved through $\pm 35^\circ$, oblanceolate or narrowly rhombic-obovate, entire or notched at apex, 8.4–11.3 mm. long, 4.2–6 mm. wide; *wings* 7.4–9.8 mm. long, the claws (3.3) 3.6–5.1 mm., the obliquely elliptic or obovate, obtuse, slightly incurved blades 4.1–6.2 mm. long, 1.7–2.6 mm. wide; *keel* 6.2–8.1 mm. long, the claws (3.3) 3.6–4.5 mm., the half-obovate or almost half-circular blades 2.9–4.2 mm. long, 1.7–2.1 mm. wide, abruptly incurved through $95\text{--}100^\circ$ to the rounded, or triangular and obscurely porrect apex; *anthers* (0.3) 0.4–0.55 mm. long; *pod* ascending or spreading, included in the calyx or almost so, sessile but elevated on an obscure, slender, glabrous gynophore up to 0.5 mm. long, the body subsymmetrically oblong-ovoid, 5.5–7 mm. long, 3–3.5 mm. in diameter, rounded at base, abruptly contracted distally into a very short, erect or declined, cusplike beak, compressed-triquetrous, with low-convex or nearly flat lateral and narrower, sulcate dorsal faces, the papery, densely tomentulose valves inflexed through the lower $\frac{2}{3}$ of the pod as an incomplete or sometimes complete septum 0.6–1.4 mm. wide; *dehiscence* apical, and part-way down through the ventral suture, after falling;

ovules (5) 6–8; *seeds* brown, smooth, dull, 1.5–1.8 mm. long.—Collections: 17 (o); representative: *J. T. Howell* 18,540 (CAS, RSA), 1424 (CAS); *Sonne* 673 (NY); *Hitchcock & Martin* 5478 (NA, WS, WTU); *Train* 4468 (NA, NY).

Dry exposed ridges and open gravelly slopes near and above timber line, 8800–10,500 feet, rare and local, known only from five summits of the Sierra Nevada enclosing Lake Tahoe to the north, west, and south; Mt. Stanford and Mt. Lola, Nevada County, Tinker's Knob, Placer County, and Mt. Tallac, Eldorado County, California; Mt. Rose, Washoe County, Nevada.—Map No. 158.—July to September.

ASTRAGALUS AUSTINAE (Rebecca Merritt Austin, 1832–1919) Gray ap. Brew. & Wats., Bot. Calif. 1: 156. 1876.—“Summit of Mount Stanford (Castle Peak), Nevada Co., at 9000 feet, Lemmon.”—Holotypus, Lemmon in 1875, GH! presumed isotypus, Lemmon 73 in 1875, NY! —*Tragacantha Austinae* (Gray) O. Kze., Rev. Gen. 943. 1891.

The Austin milk-vetch is an unusually pretty and interesting species, remarkable for its densely tufted or cushion growth-form, headlike racemes little or not exerted from the foliage, scarious, boat-shaped bracts, pubescent petals, and small pod included or nearly so within the marcescent and slightly inflated calyx. Although the small pod is reminiscent of that of *A. Spaldingii* and the pubescent petals recall *A. tyghensis*, the similarities are interpreted as the outcome of parallel but independent evolutionary processes. The close affinity of *A. Austinae* lies not with the genuine *Chaetodontes* but with *A. Andersonii*, found within only a few miles but at much lower elevations. The similarity of the two species is most easily observed in the rather unusual specimens of *A. Austinae* in which the stems (especially those from the outer ranks in large, mature plants) have become more or less strongly caulescent in their struggle outward toward the light. Isolated from the mother plant, stems of this sort are not easy to distinguish at anthesis from *A. Andersonii* except for the hairy petals and few ovules. The short, few-ovulate pod is distinct, but is essentially like that of *A. Andersonii* in structure and compression.

LXXXVI. Sectio BRAUNTONIANI

Tall perennials, with ultimately trunklike caudex; *vesture* basifixed, villous-tomentulose; *stipules* free; *leaves* imparipinnate, with 25–33 leaflets; *racemes* densely many-flowered, the retrorsely imbricated flowers small, the banner $\pm$ 9–12 mm. long; *calyx-tube* ovoid-campanulate; *petals* purplish, marcescent, regularly graduated, the banner recurved through $\pm$ 40°, the keel-tip obtuse; *pod* deflexed, sessile, deciduous, plumply lance-oblong in profile, less than 1 cm. long, bluntly triquetrous, grooved dorsally, bilocular below the beak, the valves firmly papery; *dehiscence* apical and downward through the length of both sutures, the pod separating into halves but these often retained in situ by the investing calyx; *ovules* 6–9.—Sp. 1, xerophyte, of the chaparral belt in coastal southern California.

ASTRAGALUS sect. BRAUNTONIANI (Rydb.), comb. nov., based on *Brachyphragma* sect. *Brauntoniana* Rydb. in N. Amer. Fl. 24: 399, in clave. 1929.—Sp. unica: *A. Brauntonii* Parish.

The affinities of *A. Brauntonii* are far from clear. The species, compared by Jepson (1936, p. 364) with *A. (Densifolii) pycnostachyus*, was referred by Jones (1923, p. 173, Pl. 41) to sect. *Chaetodontes* next to *A. Spaldingii* and became finally the typus of a monotypic section of *Brachyphragma* Rydb., a genus which served as a depository for miscellaneous astragali with bilocular fruits but no obviously close kindred. The Braunton milk-vetch resembles *A. pycnostachyus* in its robust stature, many leaflets, and dense racemes of small, nodding flowers, but the free stipules and bilocular pod are fundamentally different. It is a curious coincidence, nevertheless, that *A. pycnostachyus* should be represented (at least formerly) by an endemic variety along the immediate coast within the same narrow latitudinal limits. The resemblance to the genuine *Chaetodontes* is technically rather close, but the flowers of *A. Spaldingii* and *A. tyghensis* are spreading-ascending and not retrorsely imbricated; their fruits, almost beakless and bilocular into the apex, are subindehiscent, falling unopened with the calyx and pedicel upon ripening. The *Chaetodontes* are species of the Columbia Basin adapted to an environment totally different from the coastal hills of southern California, and their general appearance is not really suggestive of *A. Brauntonii*, except that all have copious and loose pubescence. The

Braunton milk-vetch also bears a strong technical resemblance to some *Micranthi*, a group of Mexican species with one outlying member in central California. Its distinguishing features are the trunklike caudex, the coarse, fistular stems, the villous-tomentulose vesture, the tumid, somewhat accrescent calyx, and the marcescent petals. Very likely it was originally derived by specialization from the same stock as the *Micranthi*, but is obviously now a greatly isolated type.

354. ASTRAGALUS BRAUNTONII

Tall, coarse perennial of rapid growth, with a thick taproot and ultimately indurated, trunklike base, densely villous-tomentulose throughout with fine, short, entangled and (especially the stems and leaf-rachises) longer, spreading, mostly wavy hairs up to (1.1) 1.3–1.7 mm. long, the stems white, the herbage canescent or greenish, the leaflets equally pubescent on both sides; *stems* several or numerous, erect and ascending (or becoming diffuse late in the year), stout, fistular, striate, 7–15 dm. long, commonly spurred at most nodes preceding the first peduncle or shortly branched upward, floriferous from about 5–12 distal axils; *stipules* submembranous becoming papery, 3–10 mm. long, deltoid- or lance-acuminate or -caudate, or the uppermost ones linear-lanceolate, pubescent dorsally, the blades deflexed, amplexicaul-decurrent around $\frac{1}{3}$ – $\frac{1}{2}$ the stems; *leaves* (3) 4–16 cm. long, the lowest shortly petioled, the rest subsessile, with 25–33 oblong-ovate or -obovate, or lance-elliptic, acute, obtuse and mucronulate, or apiculate, flat or loosely folded leaflets 3–20 mm. long, at least in age carinate dorsally by the midrib; *peduncles* spreading or incurved-ascending, 2.5–9 cm. long, much shorter than the leaf; *racemes* densely 35–60-flowered, narrowly cylindric or oblong, 15–20 mm. in diameter at full anthesis, sometimes interrupted at base, the flowers deflexed and retrorsely imbricated, the axis slightly elongating, 3.5–10 (14) cm. long in fruit; *bracts* membranous, narrowly lance-acuminate or -caudate, 2.5–5 mm. long, deflexed; *pedicels* ascending and arched outward, at anthesis 0.5–0.7 mm., in fruit thickened, (0.7) 1–1.5 mm. long; *bracteoles* 0; *calyx* 6.2–8.1 mm. long, villous-villosulous with white or partly with fuscous or black hairs, the strongly oblique, shallow disc 0.5–0.9 mm. deep, the ovoid-campanulate tube 3.3–4.1 mm. long, 3–3.8 mm. in diameter, distended dorsally at base but scarcely gibbous, the firmer, narrowly lance-acuminate or -caudate teeth 2.6–5 (6) mm. long, the whole becoming turgid, a little accrescent, papery-membranous, investing (ruptured or not) the base of the fruit; *petals* dull pinkish-purple, marcescent; *banner* oblanceolate or obovate-elliptic, shallowly emarginate or subentire, 9.1–11.7 mm. long, 4.5–5.5 mm. wide; *wings* 7.2–10 mm. long, the claws 3.3–4.6 mm., the obliquely elliptic or linear-oblanceolate, distally incurved blades 5.6–6.6 mm. long, 2–2.3 mm. wide; *keel* 6.4–8.5 mm. long, the claws 3.3–4.3 mm., the half-obovate blades 3.7–4.5 mm. long, 2.2–2.5 mm. wide, abruptly incurved through 95–100° to the rounded apex; *anthers* 0.5–0.6 mm. long; *pod* deflexed, deciduous from an incipient gynophore 0.5–0.7 mm. long, oblong or plumply lance-oblong in outline, nearly straight to gently incurved, 6.5–9 mm. long, (2.5) 3–4 mm. in diameter, obtuse or commonly retuse at base, abruptly contracted distally into an erect or slightly in- or decurved, subulate beak 1–1.5 mm. long, otherwise bluntly triquetrous, keeled ventrally by the prominent, thick suture, deeply grooved dorsally, the lateral angles broadly rounded, the green, thinly fleshy, villous or villous-tomentulose valves becoming stramineous, firmly papery, transversely reticulate beneath the vesture, inflexed through the proximal $\frac{1}{2}$ – $\frac{2}{3}$ of the pod-body as a complete or subcomplete septum 1–1.3 mm. wide; *seeds* dark brown, pitted or wrinkled but somewhat lustrous, 1.4–2 mm. long.—Collections: 14 (ii); representative: *Braunton* 1281 (CAS, DS, K, MO, POM), in 1901 (DS), in 1907 (DS, TEX); *Rixford* (from Monrovia) in 1926 (CAS); *Hastings* (from Temescal Canyon) in 1942 (NY); *C. B. Wolf* 8000 (CAS, NY, POM).

Disturbed places and natural openings in chaparral, sometimes locally abundant on fire breaks, in stiff gravelly clay soils overlying granite or sandstone, 50–1500 feet, rare and local but in good years forming considerable colonies, known only from some seven stations (some now doubtless destroyed or threatened) in the foothills surrounding the plain of Los Angeles in Los Angeles and Orange Counties, southern California: south end of Santa Monica Mountains back from the immediate coastal bluffs; Sierra Madre near Monrovia; Sierra Peak, Santa Ana Mountains.—Map No. 158.—March to July.

ASTRAGALUS BRAUNTONII (Ernest Branton, an early member of the California Botanical Society) Parish in Bull. S. Calif. Acad. Sci. 2: 26, Pl. 1. 1903.—“Above Santa Monica . . . Dr. H. E. Hasse, June 25, 1899, in ripe fruit, and May, 1902 (type) in flower and immature fruit . . .”—Holotypus, as designated by Parish, not found (1960) at DS; isotypi (3 sheets), US! paratypus *Hasse* in 1899, DS! (also POM, fragm!). A spm. collected near Sherman, June 18, 1901, *Ernest Branton*, DS (herb. Parish.), POM, should probably be accounted another paratypus.—*Brachyphragma Brauntonii* (Parish) Rydb. in N. Amer. Fl. 24: 399. 1929.

The Branton milk-vetch is a boldly handsome species, rivaling some of the coarser Old World *Alopecuroidei* in stature. Young plants are herbaceous down to the ground, but after a year or two develop a ligneous trunk several centimeters in diameter. The species is easily recognized by its tall, fistular stems whitened by a coat of spreading or entangled hairs, by the ample leaves composed of 12–16 pairs of dorsally keeled leaflets, and especially by the narrow, dense racemes of small, nodding, purplish flowers which arise from several distal axils and form a sort of panicle of spikes. As the flowers fade the petals turn brown and papery, investing with the somewhat accrescent calyx the base of the forming pod; they are not promptly shed as in most species of the genus. The Branton milk-vetch is of easy culture in southern Californian gardens and should be preserved, if not for its beauty, at least for its rarity and biological interest. The long diameter of its known natural range is about eighty miles.

LXXXVII. Sectio DIPHACI

Low, caulescent perennials, with superficial root-crown or caudex; *vesture* basifixed; *stipules* essentially free, the lowest fully amplexicaul and sometimes obscurely united (but more adnate than connate); *leaves* imparipinnate, with 13–25 leaflets; *flowers* shortly racemose, spreading or ultimately declined, small, the banner 7–9.5 mm. long; *pedicels* thickened, persistent; *calyx-tube* campanulate; *petals* purple or purplish, regularly or irregularly graduated, either the banner or the wings longest, the keel much shorter than either, obtuse at tip; *pod* spreading or declined, sessile, deciduous, plumply oblong-ellipsoid or subglobose, didymously inflated, sulcate along both sutures, bilocular, the valves stiffly papery; *dehiscence* through both sutures and the septum; *ovules* (8) 10–18.—Sp. 1, of the central Mexican plateau (Durango to Zacatecas and San Luis Potosí).

ASTRAGALUS sect. *DIPHACI* (Rydb.) L. E. James in Contrib. Dudl. Herb. 4: 65, in clave. 1951, based on *Hesperastragalus* sect. *Diphaci* Rydb. in Bull. Torr. Club 53: 165, in clave. 1926.—Sp. typica: *A. diphacus* Wats.

As originally defined by Rydberg, the sect. *Diphaci* included with the obviously typical *A. diphacus* the quite different *A. brazoensis* of our sect. *Scutanei*, an annual with peltiform pod not at all inflated but elevated on a stipelike gynophore. In his summary revision (1929) Rydberg added *Hesperastragalus peonis*, unknown to him previously, and the section so constituted was adopted uncritically by L. E. James, who simply repeated Rydberg's key in barely modified form. The section is reduced here to its nucleus of *A. diphacus* which is believed to include the still imperfectly known *A. peonis*. The *Diphaci* seem to represent a modified offshoot of sect. *Leptocarpi*. At anthesis *A. diphacus* closely resembles *A. (Leptocarpi) parvus*, so closely in fact that in San Luis Potosí fruit at least partly formed is required for certain separation of the two. However it is no great evolutionary step for a typical hamosoid pod to have acquired by simultaneous shortening and tumescence a didymously inflated, dorsiventral profile. A feature of the pod of *A. diphacus* is the prominent, closely set transverse reticulation of the valves. We have seen in sect. *Racemosi* how the pod of *A. bisulcatus*, as it becomes shorter and shorter from one

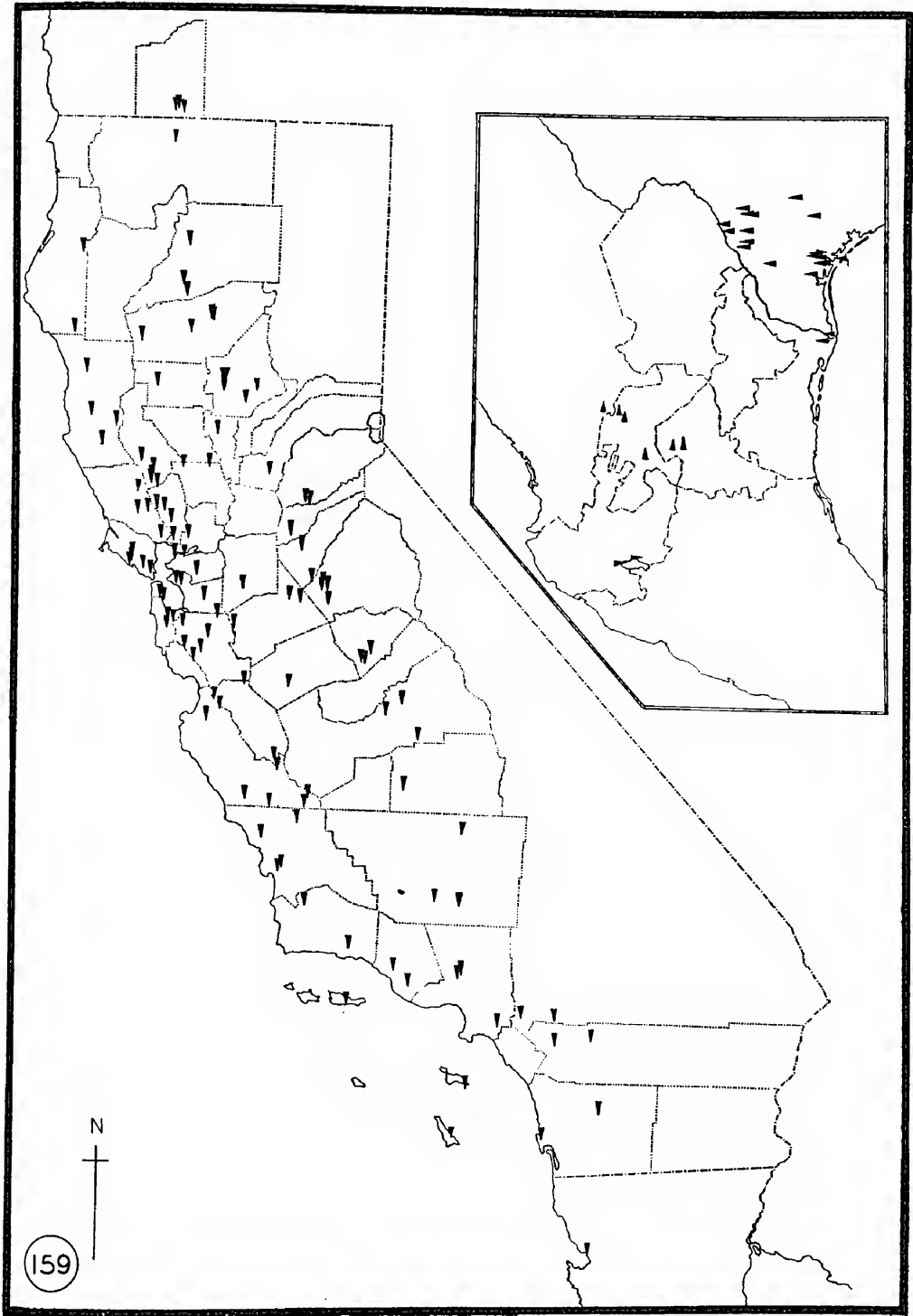
variety to the next, becomes more and more prominently reticulate. As the pod is reduced in size, the nerves become no fewer but move more closely together so that the ridges appear higher and the intervals deeper. I suspect that the prominently nerved and didymous pod of sect. *Diphaci* has evolved directly from a longer fruit of conventional hamosoid type.

355. *ASTRAGALUS DIPHACUS*

Loosely or densely tufted, perennial, with a woody taproot and knotty root-crown or shortly forking caudex, strigulose with appressed hairs up to 0.2–0.4 mm. long, the herbage greenish, cinereous, or subcanescent, the leaflets glabrous or nearly so above; *stems* several or numerous, prostrate or decumbent and incurved-ascending, (0.3) 1–3.5 (4) dm. long, simple or branched at 1–3 nodes preceding the first peduncle, floriferous from near or above the middle; *stipules* $\pm$ dimorphic, the lowest early becoming papery, fully amplexicaul, free or obscurely united opposite the petiole, the upper ones semiamplexicaul, herbaceous, with deltoid or lanceolate, commonly recurved blades 1.5–4.5 mm. long; *leaves* shortly petioled or the uppermost subsessile, (1) 1.5–6 (9) cm. long, with (9) 13–25 oblanceolate to linear-oblanceolate, truncate, obtuse, or obtuse and mucronulate, flat or folded leaflets (2) 4–13 mm. long; *peduncles* incurved-ascending at anthesis, prostrate in fruit, (2.5) 4–11.5 cm. long; *racemes* at first rather dense, mostly 10–20-flowered, the flowers early spreading and declined, the axis little elongating, (1) 1.5–6 cm. long in fruit; *bracts* submembranous, ovate or lanceolate, 1–3 mm. long; *pedicels* ascending, at anthesis 0.4–1.2 mm., in fruit thickened, persistent, 0.7–2.8 mm. long; *bracteoles* commonly 2, often minute; *calyx* 4–5.7 mm. long, strigulose with mostly dark, rarely all or mostly white hairs, the somewhat oblique disc 0.5–0.8 mm. deep, the tube 2.5–3.3 mm. long, 2–2.3 (2.5) mm. in diameter, the subulate teeth (1.3) 1.5–2.8 mm. long; *petals* purple, the color sometimes fugitive, or livid greenish-purple; *banner* recurved through 45–75°, ovate- or obovate-cuneate to broadly rhombic, shallowly notched, 7–9.6 mm. long, 3.6–5.8 mm. wide; *wings* nearly as long or up to 1.2 mm. longer, 7.2–9.8 mm. long, the claws 2.3–3.3 mm., the narrowly oblong or oblanceolate to nearly linear, obtuse or emarginate, straight or gently incurved blades 4.7–7.1 mm. long, 1.5–2.5 mm. wide; *keel* 5.1–6.8 mm. long, the claws 2.3–3.4 mm., the half-obovate blades 3–3.7 (4) mm. long, 1.8–2.5 mm. wide, incurved through 90–100° to the bluntly deltoid apex; *anthers* 0.4–0.6 mm. long; *pod* ascending, spreading, or (when crowded) declined, sessile on the conic receptacle, plumply oblong-ellipsoid to subglobose or sometimes a little broader than long and then transversely oblong, inflated or strongly tumescent but firm and scarcely bladdery, retuse at both ends, bearing a minute subulate beak in the distal sinus, sulcate along both sutures, 5–9 mm. long, 5.5–7.5 mm. in diameter, a trifle obcompressed but essentially didymous, the green but red-cheeked, thinly strigulose valves becoming stiffly papery, stramineous or ultimately blackish, prominently and closely cross-reticulate, inflexed as a complete septum $\pm$ 2–3 mm. wide; *seeds* olivaceous or dark brown, sometimes purple-speckled, smooth but scarcely lustrous, 1.8–2.1 mm. long.—Collections: 12 (iii); representative: *Lundell* 5123 (ARIZ, K, TEX, US); *Pringle* 1753 (G, K, ND, NY, P, PH, POM, fragm., US); *Palmer* 394 in 1906 (GH, NY); *Waterfall* 15,559, 15,565 (NY); *Ripley & Barneby* 13,460 (CAS, MEXU, NY, RSA, US).

Plains and stony hillsides, in arid grassland or in piñon-juniper woodland, 5600–8500 feet, locally plentiful, southern Durango to northcentral San Luis Potosí and southern Zacatecas.—Map No. 159.—July to November.

ASTRAGALUS DIPHACUS (with pod formed of twin bladders) Wats. in Proc. Amer. Acad. 17: 342. 1882.—“In the San Miguelito Mountains (816 Schaffner, mainly).”—Holotypus, collected in 1876, GH! isotypi, K, NY (dated “1879” and numbered 612/816), PH!—*Hesperastragalus diphacus* (Wats.) Rydb. in Bull. Torr. Club 53: 166. 1926.



Map No. 159. Left, California. Range of *A. gambelianus*. Upper right, parts of Mexico and southern Texas. Range of ♦ *A. brazoensis*; of ♦ *A. scutaneus*; and of ▲ *A. diphacus*.

Astragalus diphacus var. *peonis* (of the peasant laborer) Jones, Contrib. West. Bot. 10: 65. 1902.—"Zacatecas, Mexico, Jones, [May 16,] 1892."—Holotypus, POM!—*Hesperastragalus peonis* (Jones) Rydb. in N. Amer. Fl. 24: 457. 1929. *Astragalus peonis* (Jones) L. E. James in Contrib. Dudl. Herb. 4: 66. 1951.

The twin pod milk-vetch, *A. diphacus*, is a lowly astragalus with narrow leaflets, small flowers, and no special individuality when in bloom; but the pod is highly modified and remarkable. Like that of *A. crassiscarpus* on a greatly reduced scale, it varies from globose to plumply ovoid-oblong in dorsiventral profile or is so much shortened as to become broader than long and thus transversely oblong. Being recessed at both ends and bearing a minute, conic beak in the deeper, distal sinus, it might be likened to the silicle of some species of *Physaria* Gray; but although the cavity is much larger than needed to accommodate the small seeds, the valve-walls are of such firmly chartaceous texture that the pod can hardly be described as bladdery. The fruit resembles that of some *Diphysi* in form and texture but lacks a well-defined, laterally flattened beak and differs in the prominent transverse reticulation of the valves.

The identity of the so-called *A. peonis*, here reduced to *A. diphacus*, will remain controversial until better material showing flowers and fruits in organic association is acquired, for without it the immature and fragmentary typus cannot be evaluated with assurance. Rydberg (1929, l.c.) distinguished *Hesperastragalus peonis* from *H. diphacus* by canescent foliage and yellow petals contrasted with green foliage and white petals; the characters are poorly chosen. There is no difference in the type of pubescence, only in the density of it, and the petals of *A. diphacus* are normally purple, not white. It was the petals of *H. peonis* that were supposedly "white" (according to the protolog), although Jones's field note which accompanies the typus has them "yellow" (probably ochroleucous when fresh). James (1950, 1951) introduced a new specific character, having found five vascular bundles in the petiole of *A. peonis* and only three in that of *A. diphacus*. In 1961 when I examined the typus of var. *peonis*, it consisted of three stems cut off above the base, two of them each bearing one raceme of small, ochroleucous flowers and one a raceme bearing two very young forming pods. I do not hesitate to associate this latter piece with a fruiting collection (Ripley & Barneby 13,452, NY, RSA) of what I interpret as a condensed phase of *A. diphacus*, common (but in November past flowering) on stony hills surrounding the city of Zacatecas at elevations up to 8500 feet. In this singularly bleak and wind-swept habitat, the plants are densely cespitose, with short, prostrate stems and neat, silvery foliage; the pod is not only identical when young with that of the original var. *peonis*, but also identical when ripe with that of typical, greenish, and loosely tufted, purple-flowered *A. diphacus* such as Pringle (No. 1753, cited supra) collected on "hills at Zacatecas" in late October, 1888. It would appear, therefore, that if there are really two distinct astragali of the *A. diphacus* type, they are virtually sympatric and differ only in color (and a trifle in size) of the corolla. The question of petal-color may be altogether irrelevant, however. Very possibly the flowering stems on the type-sheet of var. *peonis* are not conspecific with the fruiting stem, but represent some other small- and genuinely ochroleucous-flowered astragalus (perhaps *A. hypoleucus*) native to the Zacatecas hills. If such is the case, it may be conjectured that it was this species, and not the fruiting stem, which contributed the five vascular bundles noted by James. I hesitate to suggest that so alert and experienced an observer as Jones could have been deceived by a mixture of material, but as I have noted a similar case involving the sympatric *A. amphioxys* and *A. cymboides* on the Colorado Plateau, an explanation of "*A. peonis*" in such terms is far from impossible.

LXXXVIII. Sectio REFLEXI

Slender annuals; *vesture* sparse, basifixed, hirsute-hirsutulous; *stipules* free; *leaves* imparipinnate, with about 11–19, thin-textured leaflets; *racemes* loosely but shortly few-flowered, the very small, bicolored flowers at length declined; *calyx-tube* shallowly campanulate; *petals* irregularly graduated, the lunately lance-attenuate keel-blades surpassing the white-tipped wings, about as long as the purple banner; *pod* declined, sessile, deciduous, ovoid-triquetrous, small ($\pm$ 6–9 mm. long), fully bilocular; *dehiscence* primarily basal, finally through both sutures and the septum; *ovules* 4–6 (reportedly 8).—Sp. 1, xerophyte, of eastcentral Texas.

ASTRAGALUS sect. REFLEXI Gray in Proc. Amer. Acad. 6: 197. 1864.—Sp. typica: *A. reflexus* T. & G.—*Hesperastragalus* sect. *Reflexi* (Gray) Rydb. in Bull. Torr. Club 53: 165. 1926, sens. strict. *Astragalus* subgen. *Hesperastragalus* sect. *Reflexi* (Gray) L. E. James in Contrib. Dudl. Herb. 4: 65. 1951, in clave.

The singular *A. reflexus* differs from all other annual astragali in its remarkably fashioned and proportioned flower, and derives a further measure of individuality from the submembranous foliage and sparse, stiff, hirsute vesture. By a tradition starting with Jones (1923, p. 283) the species has been associated, more or less loosely, with the Californian *A. Gambelianus* (of sect. *Microlobium*); and the section created for it by Gray, who fully stressed its unique character, was subsequently transferred by Rydberg to the genus *Hesperastragalus*. The expansion of sect. *Reflexi* to include the perennial *A. oxyrhynchus*, similar only in some aspects of the fruit, cannot be accepted. The species is evidently highly modified and taxonomically isolated.

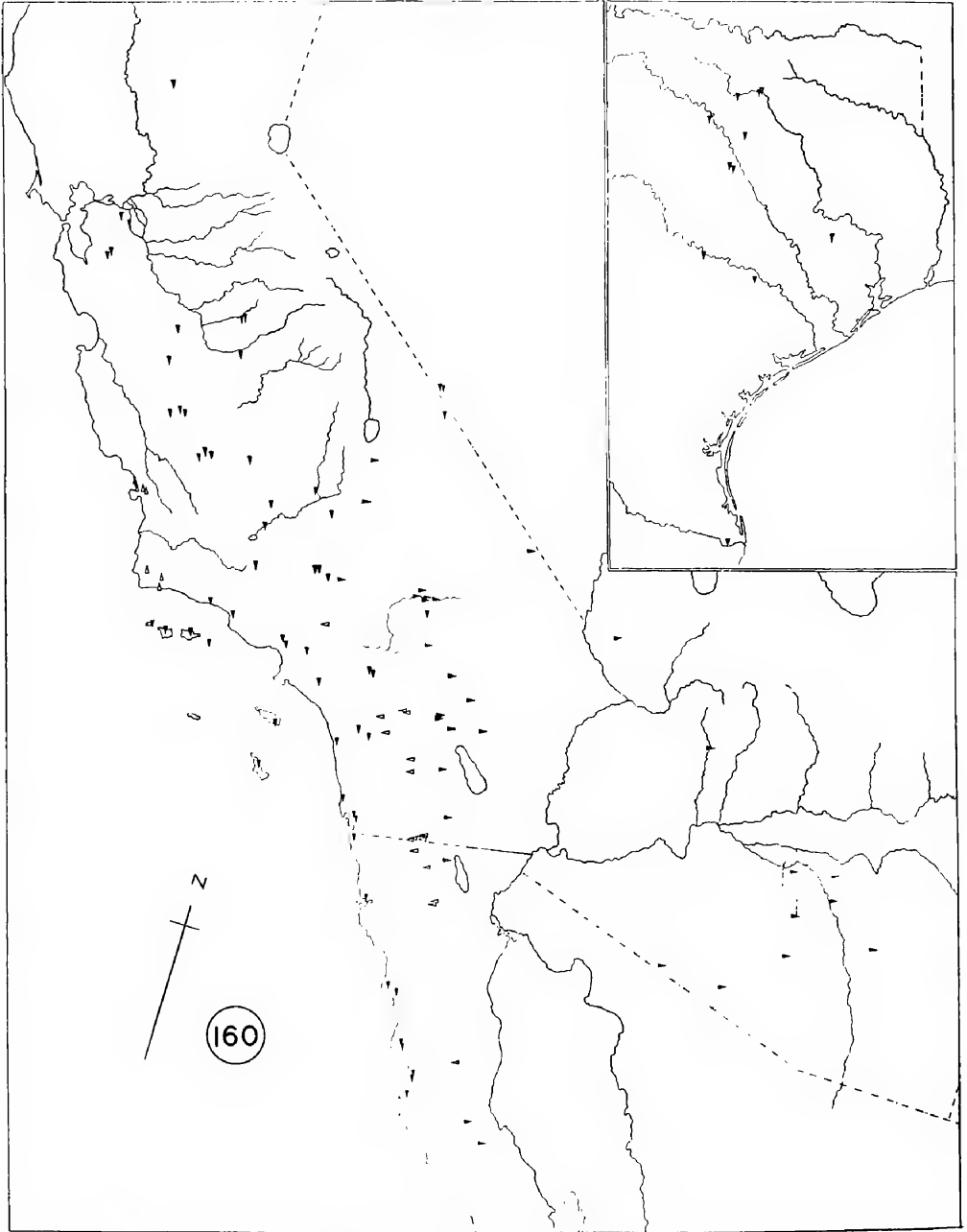
356. ASTRAGALUS REFLEXUS

Precocious winter-annual, variable in stature according to site and season, commonly slender, thinly hirsute-hirsutulous (especially upward) with rather stiff, straight, horizontal or widely ascending hairs up to 0.8–1.3 mm. long, the herbage green, the leaflets glabrous above; *stems* solitary and erect, or more often 3–several and diffuse or ascending from a slender or filiform taproot, 1–3.5 dm. long, either simple or (when robust) branched and spurred below the first peduncle; *stipules* (2) 2.5–7 mm. long, the lowest ones papery-scarious or early becoming so, semi- or almost fully amplexicaul but free, the upper ones herbaceous, larger and wider, ovate or broadly lanceolate, glabrous dorsally, the margins ciliate and often beset with a few thickened processes; *leaves* 2–8 cm. long, the lowest shortly petioled, the rest commonly subsessile, with (9) 11–15 (19) oblong-ovate, -obovate, or obovate-cuneate, sharply retuse, flat, thin-textured leaflets (3) 5–15 mm. long; *peduncles* erect or incurved-ascending, (3) 4–8.5 cm. long, equaling or well surpassing the leaf; *racemes* loosely but shortly 3–10-flowered, the flowers early spreading, ultimately declined, the axis little elongating, 4–10 mm. long in fruit, the pods loosely retrorse-imbricated; *bracts* membranous, triangular or triangular-acuminate, 0.5–1.1 mm. long, ciliate; *pedicels* at anthesis ascending, 0.5–1.1 mm. long, becoming somewhat thickened, arched outward, 0.7–1.4 mm. long in fruit, persistent; *bracteoles* 0; *calyx* 1.9–2.7 mm. long, thinly white-pilosulous, the subsymmetric disc 0.3–0.5 mm. deep, the shallowly campanulate tube 1.1–1.5 mm. long, 1.2–1.5 mm. in diameter, the subulate teeth 0.7–1.2 mm. long, the whole becoming papery, ruptured, marcescent; *petals* bicolored, the banner and keel bluish- or reddish-violet, the wings pallid or white-tipped or -margined; *banner* gently recurved through $\pm 40^\circ$, ovate- or elliptic-cuneate, 4.2–5.2 mm. long, 2.1–3.4 mm. wide, shallowly emarginate, the sinus mucronulate; *wings* (0.9–1.5 mm. shorter than the keel) 3.1–4 mm. long, the claws 0.9–1.2 mm., the narrowly oblanceolate, obtuse, slightly incurved blades 2.5–3.2 mm. long, 0.7–1.1 mm. wide; *keel* (a trifle shorter or longer than the banner) 4.3–5 mm. long, the claws 1.1–1.4 mm., the lunately lanceolate blades 3.2–3.7 mm. long, 1.1–1.5 mm. wide, gently incurved through $\pm 40^\circ$ and gradually tapering into a narrow, beaklike, ultimately obtuse apex; *anthers* 0.15–0.3 mm. long; *pod* reflexed, sessile on and disjoining from an obscure gynophore 0.1–0.5 mm. long, the body narrowly to broadly ovate or triangular-ovate in dorsiventral view, 5.5–9 mm. long, 2.5–5.5 mm. in diameter, truncate or shallowly retuse at base, abruptly contracted distally into a subulate cusp about 0.5 mm. long, triquetrously compressed, carinate ventrally by the prominent, straight or slightly incurved suture, deeply and openly sulcate dorsally, the pale green or commonly purple-speckled, glabrous valves becoming brownish, stiffly papery, prominently cross-reticulate and somewhat rugulose on the obtuse lateral angles, inflexed as a complete but narrow septum 0.4–1 mm. wide; *seeds* orange-brown or greenish, smooth but scarcely lustrous, 1.9–2.1 mm. long.—Collections: 18 (o); representative: *F. H. Wagner* 58 (SMU, TEX); *Ruth* 722 (SMU, WIS); *Reverchon* 1950 (SMU), *distrib.* *Curtiss* 594* (ND, NY); *E. Hall* 151 (NY); *Shinners* 14,174 (RSA, SMU).

Prairies and roadsides, on calcareous or black clay soils, local but sometimes

locally plentiful and of weedy occurrence, known only from eastcentral Texas, from Dallas south to Austin, extending feebly southeast onto the Gulf Coastal Plain along the Trinity and Colorado Rivers; apparently isolated on the lower Rio Grande near Brownsville, Cameron County.—Map No. 160.—February to May.

ASTRAGALUS REFLEXUS (reflexed, of the fruit) T. & G., Fl. N. Amer. 1: 334. 1838.—“Texas,



Map No. 160. Left, parts of California, Baja California, and Arizona. Range of *A. didymocarpus*: ▲ var. *didymocarpus*; △ var. *Milesianus*; ◆ var. *dispersus*; and ◇ var. *obispensis*. Upper right, parts of eastern Texas. Range of *A. reflexus*.

Drummond!"—Holotypus, *Drummond 140*, Collection II, NY (herb. Torr.)! isotypi, BM, G, GH, K ("Coll. III, in 1835"), OXF!—*Tragacantha reflexa* (T. & G.) O. Kze., Rev. Gen. 947. 1891. *Hesperastragalus reflexus* (T. & G.) Rydb. in Bull. Torr. Club 53: 165. 1926.

The Texas milk-vetch, *A. reflexus*, which must appear to the casual or uninstructed eye an inconsiderable and trifling weed, cannot fail to excite the admiration of anyone who has paused to ponder the mysterious impulses which have given rise to the protean variations on the astragaline motif. So far as I can see, no material advantage can have accrued to the species or to the individual plants, in the struggle for survival, through the modification of the tiny flower; and the remarkable, violet-purple, beaklike keel (reminiscent of *Lupinus* in outline, but lacking the function in pollenization by insects) which greatly surpasses the tiny, whitish wings and about equals the concolorous banner, seems to be the product of a sportive fancy operating outside the realm of common evolutionary pressures. Apart from the flower, the combination of scattered hirsute vesture, submembranous, retuse leaflets, and small, triquetrously compressed, sharply deflexed fruit combine to make *A. reflexus* instantly recognizable.

The Texas milk-vetch is apparently quite uncommon, and I have scanty data as to habits and ecology. Elihu Hall found it in "moist ground," which I have interpreted as temporarily wet bottomland rather than truly springy or boggy places; and Dr. Lloyd Shinnars tells me (in correspondence) that it occurs in waste and weedy places in Hill and Dallas Counties. Gray described each locule of the pod as containing 3–4 ovules, but in all ovaries examined I have found only two or three pairs.

LXXXIX. Sectio SCUTANEI

Annuals, robust or quite slender; *vesture* basifixed, scanty; *stipules* free; *leaves* imparipinnate, with 13–23 leaflets; *racemes* rather densely several- or many-flowered, the small flowers early declined, the banner $\pm$ 5–8 mm. long, the pods deflexed; *calyx-tube* campanulate; *petals* lilac or lilac-tinged, regularly graduated, the keel-tip deltoid or triangular; *pod* deflexed, sessile on and disjointing from the receptacle or from a well-developed, stipelike gynophore, broadly ovate, circular, or transversely oblong in dorsiventral view, very strongly obcompressed, pelti- or scutiform, fully bilocular but the septum very narrow, not over 1 mm. wide; *dehiscence* through both sutures and the septum, the halves separating on falling; *ovules* 4–12.—Spp. 2, annuals flowering either in early spring or in summer, one of southern Texas and Tamaulipas, one of Jalisco.

ASTRAGALUS sect. SCUTANEI, sect. nov., *Microlobio* propius affines, imprimis legumine majori maxime obcompresso pelti- vel scutiformi, pluri (saltem 4)-ovulato absimiles.—Sp. typica: *A. scutaneus* Barneby.

The two species of sect. *Scutanei* are probably not very closely related; but so far as the notably modified, disclike or shieldlike fruits are concerned, they find closer resemblances in each other than elsewhere. Their general organization is similar. The pod of *A. (Microlobium) Gambelianus* shows an approach to the extreme type of disciform obcompression exemplified by the *Scutanei*, of which the longer known member, *A. brazoensis*, has traditionally been aligned with it since Gray's Revision of 1864 (p. 198) in sect. *Didymocarpi* or some nearly allied group. Transferring it to *Hesperastragalus*, Rydberg (1926, p. 166) placed *A. brazoensis* in a new section *Diphaci* typified by the perennial *A. diphacus*, which differs greatly in its didymously inflated pod and duration of the root. This arrangement was accepted by James (1951) without comment. The section *Scutanei* differs technically from sect. *Microlobium* by the presence of more than two ovules, but the differences are much greater at the level of each individual species.

Key to the Species of Sect. Scutanei

1. Pod strigulose, sessile in the calyx, shield-shaped, with lateral angles acute or sub-acute, almost winglike; *racemes* (20) 25–40-flowered, the flowers slightly smaller than in the following, the keel 4–4.5 mm. long; *ovules* 10–12; vicinity of Lake Chapala, Jalisco 357. *A. scutaneus*
1. Pod glabrous, elevated on a stipelike gynophore at least 1.5 mm. long; *racemes* 7–20 (25)-flowered, the flowers slightly larger, the keel 5–6.5 mm. long; *ovules* consistently 4; s. Texas and adjoining Tamaulipas 358. *A. brazoensis*

357. *ASTRAGALUS SCUTANEUS*

Annual but relatively robust, with rather coarse, striate, stramineous or purplish stems 2–4.5 mm. in diameter, thinly strigulose nearly throughout with filiform or slightly flattened, straight, appressed hairs up to (0.25) 0.3–0.5 mm. long, the herbage green, the leaflets glabrous above; *stems* 1.5–3.5 dm. long, simple except for an occasional spur at the node preceding the first peduncle, floriferous upward from below the middle; *stipules* submembranous, pale green becoming scarious, pallid, and fragile, deltoid or triangular, 2.5–4 mm. long, semiamplexicaul; *leaves* sessile or the lowest ones very shortly petioled, 5–8 cm. long, with 17–23 lance-oblong, oblong, oblong-obovate, or (in some upper leaves) linear-oblong, truncate or retuse, flat or loosely folded leaflets 5–14 mm. long; *peduncles* ascending, straight or nearly so, 3.5–6.5 cm. long, shorter than the leaf; *racemes* densely (20) 25–40-flowered, narrowly oblong at full anthesis, the flowers early spreading and then declined, the axis somewhat elongating, 3–6.5 cm. long in fruit, the pods retrorsely imbricated; *bracts* membranous, triangular or triangular-acuminate, 0.8–1.8 mm. long; *pedicels* at anthesis spreading or arched outward, 0.4–0.6 mm. long, in fruit strongly recurved, 0.8–1.4 mm. long, persistent; *bracteoles* 2, minute; *calyx* 3–3.5 mm. long, minutely but sometimes densely strigulose with black or black and some paler hairs, the oblique disc 0.3–0.5 mm. deep, the campanulate, dorsally subgibbous, membranous, purplish tube 1.9–2.2 mm. long, 1.7–2 mm. in diameter, the subulate or triangular-subulate teeth 1.1–1.5 mm. long, the orifice oblique, the whole becoming papery, ruptured, marcescent; *petals* lilac or lilac-tinged, the banner purple-veined; *banner* recurved through 40–50°, obovate-cuneate or -flabellate, notched, 5.2–6 mm. long, 3.7–4 mm. wide; *wings* 5.2–5.5 mm. long, the claws 1.6–2 mm., the obliquely triangular or lunately oblong, obtuse or emarginate blades 4–4.2 mm. long, 1.5–2 mm. wide; *keel* 3.9–4.4 mm. long, the claws 1.7–2.1 mm., the half-obovate or almost half-circular blades 2.3–2.9 mm. long, 1.6–1.8 mm. wide, incurved through about 110° to the bluntly deltoid or sharply deltoid and subporrect apex; *anthers* 0.25–0.33 mm. long; *pod* deflexed, sessile, broadly ovate to nearly circular in dorsal view, 7–9.5 mm. long, 6–7.5 mm. in diameter, shallowly retuse at base, abruptly apiculate at apex, so strongly obcompressed as to become shield-shaped and almost leaflike, only 0.8–1.5 mm. thick, the lateral angles acute or subacute and almost winglike, slightly turned upward, the whole slightly incurved or obscurely sigmoidally arched, the thin, green, sparsely strigulose valves becoming papery, greenish-stramineous or purple-freckled, lustrous, translucent, strongly cross-reticulate, inflexed as a complete septum 0.5–1 mm. wide; *dehiscence* apparently through both sutures and the septum, not certainly observed; *ovules* 10–12; *seeds* olivaceous, or brown speckled with purple, smooth but dull, 1.8–2.1 mm. long.—Collections: 2 (o); representative: *Pringle 11,362* (CAS, GH, MICH, US).

Sandy soil, on lake shores and perhaps elsewhere, ±6000 feet, known only from about Lake Chapala, Jalisco.—Map No. 159.—Mid-June to September.

ASTRAGALUS SCUTANEUS (shieldlike, of the pod) Barneby in Amer. Midl. Nat. 55: 502. 1956.—“MEXICO. Sandy shore at west end of Lake Chapala, Jalisco, 14 July, 1940, C. L. Hitchcock & L. R. Stanford No. 7166 . . .”—Holotypus, WS! isotypi, CAS, GH, POM, RM, RSA, UC, UTC!

The pod of the shield milk-vetch is one of the most highly modified in the genus. Its extreme stage of dorsiventral compression, narrow, almost winged lateral angles, and slightly sigmoid curvature (proceeding downward proximally and then inward distally) are mimicked on a much larger scale by the fruit of *A. pterocarpus*, although that is of fleshy texture and unilobular. My description of the pod as persistent on the receptacle was probably mistaken, although it seems to fall more tardily than that of *A. brazoensis*, and the joint with the receptacle is less

clearly visible in young material. Truly ripe fruits showing the natural fall and dehiscence are still needed.

Pringle's collection from near Guadalajara (I have not precisely identified his Constancia Station) was distributed as *A. diphacus* and was passed over as such by Jones, Rydberg, and L. E. James. The pod of *A. diphacus*, a perennial with slightly larger flowers, is didymously inflated and the valves are divided by a very much wider septum.

358. *ASTRAGALUS BRAZOENSIS*

Annual or winter-annual, variable in stature according to site and season, dwarf and slender or quite coarse and robust, thinly strigulose with appressed or narrowly ascending, straight hairs up to (0.35) 0.4–0.75 mm. long, the herbage green, the leaflets glabrous above; *stems* 3–several from the crown of a slender taproot, ascending, or decumbent and radiating with ascending tips, (0.5) 1–3.5 (4.5) dm. long, simple when slender, when robust branched or spurred from the base upward; *stipules* ovate or deltoid, 1.5–4.5 mm. long, the lowest early becoming papery, the rest herbaceous, semi- or the lowest a little more than semi-amplexicaul, glabrous dorsally, thinly ciliate; *leaves* (2) 2.5–7.5 cm. long, the lowest petioled, the rest subsessile, with (11) 13–19 narrowly to broadly obovate-cuneate or obcordate, retuse, flat leaflets 3–10 (13) mm. long; *peduncles* erect or incurved-ascending, (3) 4–9 (11) cm. long, mostly surpassing the leaf; *racemes* rather closely 7–20 (25)-flowered, the subcontiguous flowers early spreading, declined in age, the axis little elongating, 0.7–2.5 (3.5) cm. long in fruit; *bracts* membranous, ovate-acuminate or triangular, 0.8–2 mm. long, spreading or reflexed in fruit; *pedicels* slender, at anthesis ascending, 0.5–0.8 mm. long, in fruit arched outward, a trifle thickened, 0.7–1.5 mm. long, persistent; *bracteoles* 0; *calyx* (2.7) 3–4.1 mm. long, strigulose with either white or black hairs, the oblique disc 0.4–0.6 (0.7) mm. deep, the shallowly campanulate, often purplish tube 1.6–2.4 mm. long, 1.6–2 mm. in diameter, the subulate teeth 1.1–1.8 mm. long, the orifice oblique, the whole becoming papery, marcescent unruptured; *petals* whitish, distally suffused with lilac, or bicolored, the banner then broadly purple-margined, the wing-tips white, the keel-tip always purple; *banner* recurved through $\pm 45^\circ$, sometimes further in late anthesis, obovate-cuneate, deeply or shallowly notched, (5.4) 6.7–8 mm. long, (3.7) 4.5–5.6 mm. wide; *wings* (5) 5.5–7.2 mm. long, the claws 1.7–2.3 mm., the oblong-oblongate blades (3.8) 4.3–5.6 mm. long, 1.3–2.4 (2.7) mm. wide, gently incurved through the distal half to the truncate or shallowly emarginate apex; *keel* 4.5–5.9 mm. long, the claws 1.9–2.6 mm., the obliquely triangular blades 3–4 mm. long, 1.7–2.1 mm. wide, abruptly incurved through $95\text{--}105^\circ$ to the triangular, acute or subacute, nearly always slightly porrect apex; *anthers* 0.25–0.4 mm. long; *pod* reflexed, sessile but elevated out of the calyx on a slender, often decurved, stipelike gynophore 1.5–2.3 mm. long, the body very strongly obcompressed, peltiform, subcircular in dorsiventral view or often a little wider than long, 3.5–7 mm. long, 4.5–7.5 (9) mm. in diameter, truncate or shallowly retuse at either or both ends, contracted at apex into a conic-subulate, cusplike, more or less incurved beak 0.7–1 mm. long, straight or the whole gently incurved (the ventral face then depressed in the middle and shallowly bowl-shaped), the rather firm, green or purple-tinged, glabrous valves becoming stiffly papery, brownish or stramineous, somewhat lustrous, prominently cross-reticulate and often rugulose on the narrow but obtuse lateral angles, inflexed as a narrow but complete septum 0.5–0.8 mm. wide; *dehiscence* tardy, after falling, the pod separating into two halves along both sutures and through the septum; *ovules* 4; *seeds* brown or olivaceous, smooth, somewhat lustrous, 2.3–3.2 mm. long.—Collections: 34 (i); representative: *Heller 1483* (NY, SMU, WS); *Cory 54,149* (OKLA, SMU, WS); *Small & Wherry 11,965, 12,108, 12,177* (NY); *Tracy 9091* (NY, WIS);

Jones 28,200 (CAS, OB, POM, TEX); *Ripley & Barneby 4160* (CAS, RSA).

Stony clay flats and sandy prairies, sometimes abundant and of weedy occurrence in disturbed soil along highways, 10–800 feet, widespread and locally plentiful in favorable seasons on the Gulf Coastal Plain of southern Texas in the drainage of the San Antonio and Nueces Rivers and the lower Rio Grande, extending just south into adjoining Tamaulipas.—Map No. 159.—February to April.

ASTRAGALUS BRAZOENSIS (of the Brazos River) Buckl. in Proc. Philad. Acad. 1861, p. 454. 1861.—“Western Texas.”—Holotypus, collected in June, 1861, by Samuel Botsford Buckley, PH! isotypus, GH (fragm.)!—*Tragacantha brazoensis* (Buckl.) O. Kze., Rev. Gen. 943. 1891. *Hesperastragalus brazoensis* (Buckl.) Rydb. in Bull. Torr. Club 53: 166. 1926.

The Brazos milk-vetch is chiefly remarkable for its discoid pod which, as seen from above, is either circular or often wider than long and then almost transversely oblong and is, moreover, elevated out of the calyx on a decurved, stipelike gynophore often described in the past as a genuine stipe. The two faces of the fruit may be nearly flat, or with a slight inward curvature the ventral face becomes depressed in the middle to form a shallow bowl or saucer. Other notable features of *A. brazoensis* are the precise, consistent number of the four ovules, of which only one or both of each locule may ripen into viable seeds; and the minute puberulence of the style just below the stigma. This character is shared, apparently fortuitously, with another Texan annual, *A. Lindheimeri*, a species very different in its truly stipitate, ascending, compressed-tri-quetrous pod and much fewer and larger flowers.

The name of the Brazos milk-vetch is apparently a misnomer, for I find no modern record from the valley of the Brazos River, or from the county of the same name, the known eastern limit of the species lying in northern Aransas County on the coast and inland along the San Antonio River in Bexar and Karnes Counties. A collection ostensibly from the Pease River near Matador in Motley County (i.e., near the southeast corner of the Panhandle; cf. *Small & Wherry 12,177*, NY) is probably mislabeled. Another (*Small & Wherry 11,776*, NY), supposedly from Liberty County in the southeast corner of the state, needs verification and has been omitted from the map.

XC. Sectio MICROLOBIUM

Slender annuals, erect or diffuse, flowering in spring; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, with 7–17 leaflets; *flowers* small or very small, the banner 2.5–9.5 mm. long, disposed at least at early anthesis, often permanently, in dense, ovoid or oblong heads; *calyx-tube* campanulate or turbinate, becoming ovoid-campanulate, papery, ruptured but persistent; *petals* whitish lilac-tinged, or purple, regularly graduated, but the slightly recurved banner often little longer than the obtuse or sometimes triangular-acute keel; *pod* variably oriented, sessile, deciduous, ovate or circular in dorsiventral view, about 2–4 mm. long, variably compressed, rugulose-reticulate on the lateral angles or over the whole surface, fully bilocular, the valves papery; *dehiscence* by fracture through both sutures and the septum, the halves of the pod falling apart into 2 essentially indehiscent, 1-seeded, saclike lobes; *ovules* 2.

The section *Microlobium*, here redefined in its original, narrowest sense, contains only *A. didymocarpus* and *A. Gambelianus*. Both primarily Californian, and sympatric over large areas lying between the Sierra and the Pacific Ocean, they have traditionally been regarded as close relatives, although they are sharply distinguished by characters of flower and fruit which would no doubt appear much more immediately impressive if magnified several times. The most important feature common to both is the dehiscence of the pod by fracture through both sutures and the septum, the halves of the fruit separating into two lobes which assume the character of sacs, each closed by its half of the dissepiment and containing one, proportionately massive seed. Germination of the seeds apparently occurs under natural conditions within the husk of the pod, from which the seed itself can hardly escape except by gradual weathering of the closely-fitting envelope. The differences in the form and orientation of the fruits, summarized in the following subsectional key, are of such magnitude in the context of the genus that they provide an ample basis for the recognition of two monotypic subsections.

So far as the pod is concerned, and probably in other respects also, the section *Microlobium* represents a peak of evolutionary development. Through the medium of *A. reflexus* it is possible to derive the pod of *A. didymocarpus* from the "hamosoid" type exemplified by that of *A. Pringlei* or *A. Clevelandii* through modifications simultaneously involving a great shortening and reduction of the ovules to a single pair. It is interesting to compare the pod of *A. Gambelianus* with that of the Old World *A. Epiglottis* L., similarly oriented and fashioned, although the latter species is very likely derived from the same ancestry as sect. *Sesamei*, which has erect and longer pods. The rugulose-reticulate surface of the pod in sect. *Microlobium*, of which Rydberg made so much, is a product of the shortening process which has produced the tiny fruits; the nerves (as in *A. bisulcatus* var. *Haydenianus*, or *A. gracilis*) being scarcely less numerous than in a legume of greater size, here perforce are crowded together and separated by narrow and proportionately deep troughs.

Gray's sect. *Didymocarpi* should perhaps be listed as a mere substitute for *Microlobium*, which was mentioned as a synonym in the original publication; but since Gray there recast the limits of the group to admit the Texan *A. brazoensis* with its "stipitate," 4-ovulate pod, I have treated it as an independent proposition. The scope of sect. *Didymocarpi* was extended by Jones (1923, p. 283) to include *A. reflexus*, *A. Breweri*, *A. diphacus*, and *A. angelinus* (= *A. oxyrhychnus*), now removed to other sections where the differential characters are more fully noted. The genus *Hesperastragalus* as elaborated by Rydberg (1926, p. 165, sequ.; 1929, p. 455, sequ.) was substantially equivalent except for the exclusion of *A. Breweri*, although the sect. *Didymocarpi* within the genus was defined as narrowly as the present *Microlobium*. James (1951) adopted Rydberg's circumscription of the species-groups within her subgenus *Hesperastragalus*, only altering the order of presentation to conform with a debatable hypothesis of an evolutionary sequence traceable through modification of the pod's compression and gradual acquisition of septum. My views on this subject are presented in the introduction to this volume.

Key to the Subsections of Sect. *Microlobium*

1. Flowers at full or late anthesis nodding or declined on arched pedicels; *racemes* dense and headlike at early anthesis, ultimately elongating, the pods thus quite loosely retrorse-imbricated; *pod* strongly obcompressed, broadly ovate or suborbicular in dorsiventral view, widely and shallowly sulcate dorsally, the flattened halves divergent and their narrow but obtuse angles incurved proximally toward the straight or gently concave ventral suture; cismontane from s. Oregon to n. Baja California ————— XC (i). subsect. *Gambeliani*
1. Flowers and fruits permanently erect and ascending on very short, straight pedicels; *racemes* permanently dense, ovoid or cylindro-oblong; *pod* plumply ovoid or subglobose, a trifle compressed laterally, carinate ventrally by the prominent, straight or slightly convex suture, the body divided by a deep, narrow, dorsal sulcus into two saclike connivent lobes; cismontane in California s.-ward from the Sacramento delta to n. Baja California, e. through the deserts to s. Nevada, s. Arizona, and n. Sonora ————— XC (ii). subsect. *Microlobium*

XC (i). Subsectio GAMBELIANI

Characters as given in the key.—Sp. 1, xerophyte, of cismontane California, adjoining islands, extreme southern Oregon, and northern Baja California.

ASTRAGALUS sect. MICROLOBIUM subsect. GAMBELIANI, subsect. nov., a *Microlobio* sensu stricto floribus mox declinatis, legumine reflexo, valde obcompresso (subscutiformi) absimiles.—Sp. unica: *A. Gambelianus* Sheld.

359. ASTRAGALUS GAMBELIANUS

Usually very slender, sometimes diminutive, with a subfiliform taproot, pilosulous nearly throughout with loosely ascending, incurved, or rarely subappressed, straight or partly sinuous hairs up to 0.35–0.7 (0.75) mm. long, the herbage green or greenish-cinereous, the leaflets commonly pubescent on both sides, but often more thinly so or medially glabrescent above, the inflorescence nearly always black-hairy; *stems* solitary and erect, or several from near the base, the outer ones then either decumbent or incurved-ascending, 3–23 (30) cm. long, simple or (when robust) few-branched or -spurred below the middle, often floriferous nearly from the base, becoming wiry and zigzag distally in age; *stipules* submembranous, pallid or green- or purple-tinged, becoming papery, ovate, deltoid, ovate-acuminate, or

lanceolate, (1) 1.5–3 mm. long, semi- to almost fully amplexicaul but free; *leaves* 1–3.5 (4) cm. long, the lowest slender-petioled, the upper ones sessile or nearly so, with 7–13 (15) oblanceolate, linear-oblanceolate, or broadly to narrowly cuneate, sharply retuse, flat or loosely folded, often purple-margined leaflets (1) 2–9 mm. long; *peduncles* subfiliform, erect, divaricate-, or incurved-ascending, (1) 2–5 (6) cm. long, well surpassing the leaf; *racemes* 4–15-flowered, dense and headlike in early anthesis, the flowers at first ascending, then spreading and finally declined, the axis soon elongating, 3–20 (27) mm. long in fruit; *bracts* membranous, pallid, ovate or lanceolate, 0.5–1.3 mm. long; *pedicels* at early anthesis ascending, 0.2–0.5 mm. long, soon arched outward, ultimately recurved, somewhat thickened, in fruit 0.5–0.9 mm. long, persistent; *bracteoles* 0; *calyx* 1.8–2.3 (2.5) mm. long, pilosulous with black (exceptionally white) hairs, the subsymmetric disc 0.2–0.4 mm. deep, the campanulate, turbinate, or (at late anthesis) ovoid-campanulate tube 1.1–1.7 mm. long, 1.1–1.5 mm. in diameter, the subulate or triangular-subulate teeth 0.5–0.9 mm. long, the whole becoming papery-scarious, ruptured, marcescent; *petals* whitish tinged, veined, or margined with bluish-lilac, sometimes bright violet, the keel marcescent; *banner* gently recurved through about 25°, oval-elliptic, -obovate, or rarely spatulate, commonly 2.5–3.3 mm. long, 1.5–2 mm. wide, rarely obovate-cuneate and up to 5.5–6.5 mm. long, 3.2–4.2 mm. wide, subentire, shallowly emarginate, or rarely retuse at apex; *wings* 2.2–2.7 (4.6–5.4) mm. long, the claws 0.8–1.2 (1.7–1.9) mm., the narrowly to broadly oblong (oblong-oblanceolate), obtuse, nearly straight blades 1.5–1.9 (3.3–3.8) mm. long, 0.5–0.8 (1.3–1.5) mm. wide; *keel* 2–2.5 (3.2–4.2) mm. long, the claws 0.9–1.2 (1.3–2) mm., the blades commonly subquadrangular, 1.1–1.5 mm. long, 0.8–1.1 mm. wide, incurved through 90°, exceptionally half-orbicular, 2–2.4 mm. long, 1.2–1.5 mm. wide, incurved through 100°, the apex bluntly deltoid; *anthers* 0.15–0.22 (0.25–0.3) mm. long; *pod* deflexed, sessile, broadly ovate, rhombic-ovate, or nearly circular in dorsal view, 2.8–4.2 mm. long, 2.4–3.6 mm. in diameter, rounded or broadly cuneate and often a trifle retuse at base, abruptly contracted distally into a minute, conic-mucronate beak, strongly obcompressed, very widely and openly sulcate dorsally, the narrow, rugulose-reticulate lateral angles more or less incurved proximally toward the prominent, straight or gently concave-arcuate ventral suture, the thin, green valves hirsutulous (strigulose) with spreading or incurved (more rarely appressed) hairs up to 0.25–0.4 mm. long, becoming papery, stramineous or brownish, inflexed as a complete or subcomplete septum 0.3–0.7 mm. wide; *seeds* oblong, light or dark brown, sometimes purple-speckled, smooth or nearly so, somewhat lustrous, 1.8–2.3 (2.6) mm. long.—Collections: 111 (xiv); representative: *Peck 24,911* (CAS, RSA); *C. F. Baker 718* (CAS, ND, NY); *Heller 11,273* (CAS, ND, NY); *Jones 3229* (NY, POM, WS); *Barneby & Howell 11,464* (CAS, RSA); *Barneby 11,572* (CAS, RSA).

Open grassy hillsides, valley floors, clearings in chaparral, sometimes in shade of live oaks, in various sandy or clayey soils, sometimes locally abundant on serpentine, 50–2900 (or according to Jepson to 4000) feet, widespread and common throughout the greater part of cismontane California: Sierra foothills from Shasta south to Fresno County; North Coast Ranges inland from the redwood belt, from the lower Trinity River southward; South Coast Ranges, where reaching west to the coast and Channel Islands (Catalina and Santa Cruz); thence south, becoming rarer and somewhat scattered, through cismontane southern California (San Fernando and San Bernardino Valleys to interior San Diego County) to extreme northern Baja California; southern Jackson County, Oregon.—Map No. 159.—March to July.

ASTRAGALUS GAMBELIANUS (William Gambel, 1821–1849, physician, ornithologist, friend

of Nuttall, one of the first naturalists in California) Sheld. in Minn. Bot. Stud. 1: 21. 1894 ("gambellianus"), an orthographic error, for Sheldon, perhaps following Gray's annotation of the isotypus at GH, spelled the collector also "Gambell"), based on *A. nigrescens* (blackening, from the black-hairy racemes) Nutt. in Jour. Acad. Philad. II, 1: 153. 1848 (non *A. nigrescens* Pall., 1800)—"With the above," i.e., *A. catalinensis*, "On the island of Catalina, in Upper California."—Holotypus, labeled in Nuttall's hand: "Astragalus *nigrescens. Catalina.," PH! isotypus, GH (fragm.)!—*Hesperastragalus Gambelianus* (Sheld.) A. Hell., Muhlenbergia 2: 87. 1905.

Astragalus Elmeri (Elmer Drew, "one of the first to collect it") Greene in Erythea 3: 98. 1895.—"Apparently a local species in Ross Valley, Marin Co., California..."—Holotypus, collected April 21, 1895, by E. L. Greene, ND (3 sheets)! paratypus, collected in Marin County, April 15, 1891, by Elmer Drew, ND!—*Hesperastragalus Elmeri* (Greene) Rydb. in Bull. Torr. Club 53: 168. 1926. *Astragalus Gambelianus* subsp. *Elmeri* (Greene) Abrams, Ill. Fl. Pac. St. 2: 610. 1944. *A. Gambelianus* var. *Elmeri* (Greene) J. T. Howell in Leaf. West. Bot. 5: 107. 1948.

The Gambel milk-vetch, or "Little Bill Loco" (so called by Jepson, with no proof that it is poisonous) is the most widely dispersed and numerically abundant astragalus in California. Because of the small size of the flowers and fruits it is an inconspicuous plant, probably often overlooked; the beauty of the nearly always black-pubescent inflorescence and the uniquely fashioned pod can be appreciated only at the closest quarters. The species varies little. The pod is usually hirsutulous with curly or incurved hairs, but a form, otherwise indistinguishable, with the hairs upwardly appressed and nearly straight was recognized by Rydberg (1926, p. 168) as *Hesperastragalus Elmeri* (although not the original *A. Elmeri* of Greene, mentioned further below). I (1950, p. 214) regarded it as a minor variant as did James (1951, p. 71), despite its relatively restricted range along and near the coast from San Francisco south to Los Angeles. The true *A. Elmeri* Greene is a much more striking variant in which the corolla is almost twice longer than that of normal *A. Gambelianus*, the banner about 5.5–6.5 mm. long, and other petals in proportion (as noted in parentheses in the description). A very pretty and comparatively showy little plant, *A. Elmeri* is known chiefly from southern Marin County, particularly from the north slope of Mount Tamalpais (Fairfax Hills; Ross Valley; San Anselmo Canyon), where it has been collected at intervals since 1891 (cf. J. T. Howell 16,942, 21,577, CAS) and is evidently self-productive. I have already called attention (1950, l.c.) to an approximate topotype (Ross Valley, Michener & Bioletti in 1892, NY) consisting of a mixture of small- and large-flowered plants apparently growing together. I have since seen a collection from the Sierra foothills in Amador County (K. Curran, in May, 1886, WS) in which one individual plant among several (including the duplicate at NY) normal examples of *A. Gambelianus* has a banner 5.5 mm. long. For the present I regard *A. Elmeri* as a notable variant of uncertain status.

NC (ii). Subsectio MICROLOBIUM

Both flowers and fruits erect or narrowly ascending, in dense, capitate or oblong, spiciform racemes; *pod* subglobose, but a trifle flattened laterally, with plumply rounded sides and deep, narrow dorsal sulcus.—Sp. 1, polymorphic xerophyte, of cismontane California and northern Baja California, extending east and south through the southern Mohave and Colorado Deserts to southern Nevada, southern Arizona, and northern Sonora.

ASTRAGALUS sect. MICROLOBIUM Nutt. in Jour. Acad. Philad. II, 1: 152. 1848, sens. strict. —Sp. typica: *A. catalinensis* Nutt. = *A. didymocarpus* H. & A. var. *didymocarpus*.

Astragalus sect. *Didymocarpi* Gray in Proc. Amer. Acad. 6: 198. 1864.—Sp. typica: *A. didymocarpus* H. & A.—*Hesperastragalus* sect. *Didymocarpi* (Gray) Rydb. in Bull. Torr. Club 53: 166. 1926. *Astragalus* subgen. *Hesperastragalus* sect. *Didymocarpi* (Gray) L. E. James in Contrib. Dudl. Herb. 4: 65. 1951, in clave.

Astragalus sect. *Dispermus* Sheld. in Minn. Bot. Stud. 1: 163. 1894.—Sp. typica: *A. dispermus* Gray = *A. didymocarpus* var. *dispermus* (Gray) Jeps.

Hesperastragalus A. Hell., Muhlenbergia 2: 86. 1905.—Generitypus: *H. didymocarpus* (H. & A.) A. Hell. = *A. didymocarpus* H. & A.—*Astragalus* subgen. *Hesperastragalus* (A. Hell.) L. E. James in Contrib. Dudl. Herb. 4: 63. 1951.

Astragalus subgen. *Didymocarpi* Tidest. & Kitt., Fl. Ariz. & New Mex. 221. 1941.—Sp. lectotypica: *A. didymocarpus* H. & A.

360. ASTRAGALUS DIDYMOCARPUS

Variable in stature according to race, site, and season, usually quite slender, with slender or subfiliform taproot and 1–3 erect, ascending, decumbent and dis-

tally incurved, or truly prostrate primary stems 2.5–3.5 cm. long, either simple or diffusely branched near the base, thinly to quite densely strigulose or strigose-hirsutulous with straight or nearly straight, appressed or loosely ascending hairs up to (0.3) 0.4–0.75 mm. long, the herbage green, cinereous, or canescent, the leaflets pubescent on both sides or more commonly either glabrous or medially glabrescent above, the inflorescence densely villosulous or pilosulous; *stipules* thinly herbaceous becoming pallid and papery-membranous in age, (0.6) 1–5 mm. long, the short lower ones deltoid or ovate, the rest ovate-triangular to lance-acuminate, with spreading blades, all semi- or the lowest a little more than semiamplexicaul, glabrous or nearly so dorsally, ciliate, and the margins sometimes beset with a few minute, tack-shaped processes; *leaves* 0.8–7.5 cm. long, the lower ones slender-petioled, the rest very shortly so or subsessile, with (9) 11–17 linear, linear-oblong, -elliptic, oblanceolate, oblong-cuneate, or exactly cuneate, deeply retuse or (in some lower leaves) shorter and obcordate, flat or loosely folded leaflets 1.5–14 mm. long; *peduncles* slender, erect or incurved-ascending, (0.5) 1–8 cm. long, all shorter, all longer, or the lower ones shorter and the upper longer than the leaf; *racemes* densely (5) 7–30-flowered, the erect and ascending flowers crowded into ovoid, subglobose, or oblong-cylindric heads at full anthesis 6–15 mm. in diameter, the axis not or scarcely elongating, 2–20 (22) mm. long in fruit; *bracts* membranous, pallid, ovate- or lance-acuminate, 0.6–3 mm. long; *pedicels* erect, often very short or subobsolete, at anthesis 0.1–0.4 mm., in fruit 0.2–0.5 (0.6) mm. long, naturally persistent but not thickened and readily disjoining under pressure; *bracteoles* 0; *calyx* 3–5.4 mm. long, densely pilosulous or villosulous (villous) with spreading or loosely ascending, black, white, or mixed black and white hairs up to 0.55–1 (1.1) mm. long, the subsymmetric, campanulate or turbinate disc 0.3–0.5 (0.6) mm. deep, the campanulate or at length ovoid-campanulate, pallid, submembranous tube (1.6) 1.7–3.2 mm. long, the subulate or subulate-setaceous teeth varying from much shorter to a little longer, the whole becoming papery-scarious, at first distended but finally ruptured and marcescent about the lower half, or fully investing the whole pod; *petals* whitish tinged with lavender, or pink-purple with white or pallid wing-tips, the purple turning bluish when dry; *banner* recurved through $\pm 25^\circ$, oblanceolate, spatulate- or rhombic-oblanceolate, or obovate-cuneate, shallowly notched, about 4–9.5 mm. long; *wings* a little shorter, the blades linear-oblanceolate, narrowly obovate, or rarely lanceolate, obtuse, straight or slightly incurved; *keel* 3–7.2 mm. long, variable in shape; *anthers* 0.15–0.4 mm. long; *pod* erect or (due to crowding) spreading, sessile, plumply ovoid or subglobose, 2–4 mm. long, a little laterally compressed, carinate ventrally by the prominent, thick, straight or low-convex suture, gibbous-convex and deeply sulcate dorsally, the sulcus either open and narrow, or closed by the connivent lobes of the fruit, the thinly fleshy, green or purple-tinged, densely to quite thinly strigose-hirsutulous or rarely glabrous valves becoming stiffly papery, brownish, transversely reticulate by 4–6 (7) prominent nerves ascending from the ventral suture and nearly always elevated at maturity into prominent, sharp- or blunt-edged corrugations, the obtuse lateral angles thus strongly rugulose, inflexed as a complete or sometimes incomplete septum 0.2–0.5 (0.8) mm. wide; *seeds* olivaceous, ochraceous, orange, or brown, more or less rugulose, dull or somewhat lustrous, 1.4–2.3 mm. long.

Although much more variable and polymorphic than *A. Gambelianus*, the two-seeded milk-vetch, *A. didymocarpus*, is less so than might be inferred from the number of segregates which have been proposed or from the synonymy listed in the following pages. It cannot be overemphasized that the pod remains essentially uniform throughout the species, whereas the differential characters of the varieties, which involve only slight modifications in flower-size, propor-

tions of the calyx-tube and -teeth, shape of the keel-tip, habit of growth, and distribution or density of the vestiture, only assume importance insofar as they are correlated with patterns of dispersal. I refer here to the macroscopic morphological features of the plants, those visible to the naked eye or under magnification of ten diameters. After experimental study and comparison of the anatomy and embryology of the *Didymocarpi*, James (1950, 1951, *passim*) recognized two species within the *A. didymocarpus* of these pages, separable in the following terms:

1. Early trifoliate leaves usually 3 in number, rarely 2 or 1; vascular bundles in the petioles 5; $n = 13$ *A. dispersus*
1. Early trifoliate leaves 0 to 2; vascular bundles 3; $n = 12$ *A. didymocarpus*

Since James's papers appeared in print, no opportunity has arisen to reassemble the amount of material necessary for a systematic appraisal of the vascular anatomy of the petiole; but it seems to hold out little hope of clarifying the taxonomy if the coastal *A. Milesianus*, which so closely resembles *A. didymocarpus* in all but flower-size, is to be referred to *A. dispersus* because of its five bundles. The early trifoliate leaves which immediately succeed the cotyledons wither quickly and are lacking from most herbarium specimens. Before any satisfactory division of the complex can be attained, it will be necessary to have chromosome counts of var. *obispensis* and var. *Milesianus*, as well as further data about populations which seem, on morphological grounds, to be intermediate between *A. didymocarpus* and *A. dispersus*. While James's observations are of the greatest interest and point up the immensity of our ignorance of the finer points of anatomy in *Astragalus*, I must leave the assessment of her results to the future. And if no better key character can be found to distinguish these two supposed species than the color of the calyx-hairs (James, 1951, p. 65), which would lead to the most contradictory results in practice, the comprehensive view of a pluriracial *A. didymocarpus* presented here will probably find favor with the majority of botanists.

Key to the Varieties of *A. didymocarpus*

1. Flowers small, the keel 2.4–4.5 mm. long (2)
 2. Calyx (at least the teeth) largely or partly black-hairy, the teeth (mostly 0.8–1.4 mm., rarely up to 2 mm. long) shorter than or rarely equaling the tube; *stems* characteristically erect; *herbage* usually green or greenish, the leaflets glabrescent above; San Joaquin Valley s. from Contra Costa County and S. Coast Ranges; cismontane s. California and Channel Islands, to n. Baja California; s.-w. and centr. Mohave Desert; Death Valley region, just reaching s. Nevada 360a. var. *didymocarpus*
 2. Calyx mostly white-, the teeth sometimes sparingly black-hairy, the whole more densely villous than the preceding, and the teeth (mostly 1.6–2.4, rarely as little as 1.3 mm. long) usually well, or at least slightly, longer than the tube; *stems* characteristically prostrate; *herbage* canescent or rarely greenish-canescens; s. Mohave and Colorado Deserts, to s. Arizona, n. Baja California, and n. Sonora 360c. var. *dispersus*
1. Flowers larger, the keel (4.7) 5.2–7.2 mm. long (3)
 3. Keel abruptly incurved and the apex bluntly deltoid; coastal San Luis Obispo and Santa Barbara Counties 360b. var. *Milesianus*
 3. Keel lunately half-elliptic, incurved to a narrowly triangular, acute or subacute, often beaklike apex; interior cismontane s. California, extending just to the desert edge, Los Angeles County s. to n. Baja California, there apparently extending w. to the coast 360d. var. *obispensis*

360a. *ASTRAGALUS DIDYMOCARPUS* var. *DIDYMOCARPUS*

Herbage green or greenish-cinereous, the vestiture commonly sparse, appressed or nearly so, the leaflets glabrous or thinly pubescent near the margins above; *stems* characteristically erect or ascending, more rarely (especially in exceptionally dry or compact soils) diffuse and freely branched, (2.5) 4–35 (45) cm. long; *leaves* (0.8) 1.5–7.5 cm. long, the (9) 11–17 leaflets 1.5–14 mm. long; *racemes* (5) 7–25-flowered, at full anthesis 5–8 mm. in diameter, the axis 2–15 (22) mm. long in fruit; *calyx* 2.5–3.8 (4) mm. long, densely pilosulous with rather stiff, straight, spreading or loosely ascending, black and white or largely black hairs up to 0.5–0.8 mm. long, the tube 1.5–2.8 mm. long, 1.3–2 mm. in diameter, the subulate teeth 0.8–1.4 (2) mm. long; *banner* 2.8–5.3 (6.1) mm. long, 1.6–2.5

(3) mm. wide; *wings* 2.8–4.8 (5.2) mm. long, the claws 1.2–2.4 mm., the blades 1.8–3 (3.2) mm. long, (0.6) 0.8–1.2 mm. wide; *keel* 2.4–4.3 (4.5) mm. long, the claws 1.3–2.4 mm., the half-obovate blades 1.2–2.3 (2.6) mm. long, 0.8–1.2 (1.5) mm. wide, abruptly incurved through 90–95° to the blunt, deltoid apex; *anthers* 0.15–0.25 (0.3) mm. long; *pod* (2) 2.3–3.4 (4) mm. long, 1.5–3 mm. in diameter, strigulose throughout or in the distal half only, the hairs sometimes appearing loose on the corrugated angles.—Collections: 71 (iv); representative: *Wiggins & Ferris* 9360 (NY, TEX, WS); *Raven* 9220 (CAS, RSA); *C. B. Wolf* 6373 (CAS, TEX, WS), 6659 (CAS, WS), 10,295 (CAS, NY, TEX, WS); *Jones* 3152 (NY, POM, TEX); *Palmer* 614 (CAS, NY); *Wiggins* 5232, 5245 (CAS, NY).

Grassy hillsides, rolling plains, and valley floors, widespread and locally abundant below 2200 feet in the South Coast Ranges and adjacent Great Valley of California, from the lower Sacramento Valley in Contra Costa County southward in scattered stations near the coast to lat. 30° N. in Baja California, coming out to the Pacific Coast southward from Santa Barbara County and the Channel Islands (all but San Nicolas and Santa Barbara), extending rarely east into the Sierra foothills in Madera County, and ascending to 4400 (5080) feet in the mountains of Ventura County; also on sandy flats and stony washes, with *Larrea* and Joshua-tree, up to 3100 feet, in the southwestern and (rarely) central Mohave Desert; and apparently isolated at 3800–4400 feet on both slopes of the Funeral Range in southern Nye County, Nevada, and adjoining Inyo County, California.—Map No. 160.—March to May.

ASTRAGALUS DIDYMOCARPUS (with pod divided into twin lobes) H. & A., Bot. Beechey Voy. 334, Pl. LXXXI. 1840.—“California, Douglas.”—Holotypus, collected in 1833, K! isotypi, BM, G, K, NY, OXF!—*Tragacantha didymocarpa* (H. & A.) O. Kze., Rev. Gen. 944. 1891. *Hesperastragalus didymocarpus* (H. & A.) A. Heller, Muhlenbergia 2: 218. 1905.

Astragalus catalinensis (of Catalina Island) Nutt. in Jour. Acad. Philad. II, 1: 152. 1848.—“On the island of Catalina, in Upper California,” collected by Dr. William Gambel.—Holotypus, labeled “*A. Catalinensis* Nuttall, from Gambel,” K!—*Hesperastragalus catalinensis* (Nutt.) Rydb. in Bull. Torr. Club 53: 169. 1926.

Hesperastragalus compactus (dense, of the raceme) A. Heller, Muhlenbergia 2: 218. 1906.—“The type is no. 8156, collected April 11, 1906, on grassy hills near Pollaskey, Fresno County, California.”—Isotypi (*A. A. Heller* 8156), GH, MO, NY, US!

? *Astragalus didymocarpus* var. *daleoides* (resembling some annual daleas in habit and calyx) Barneby in El Aliso 2: 212. 1950.—CALIFORNIA: Cholame, San Luis Obispo Co., 5 May 1926, *Eastwood* 13875, in part; *ibid*, 25 March 1935, *J. T. Howell* 2026, in part . . .—Cotypi, CAS!

The prevailing form of the typical two-seeded milk-vetch, var. *didymocarpus*, is a slender plant with a solitary or several erect or ascending stems, green herbage with leaflets varying from oblong to linear (the latter commonest southward and on the Channel Islands), and capitate or narrowly oblong, black-hairy flower-heads about 5–8 mm. in diameter. A diffuse form, in which the short-toothed calyx of var. *didymocarpus* is combined with the diffuse growth-habit of var. *dispermus*, occurs in semidesert environment on the floor of the San Joaquin Valley (e.g., *J. T. Howell* 5870, CAS); and there is difficulty in distinguishing them where these two varieties converge in the western Mohave Desert. The occurrence of var. *didymocarpus* in characteristic form in the Death Valley region, somewhat doubtfully recorded earlier (Barneby, 1950, p. 212), has been confirmed by recent collections (e.g. *J. & L. Roos* 6086, NY). It is apparently established on both slopes of the Grapevine and Funeral Ranges, though whether truly native there is open to question. The pod of var. *didymocarpus* varies from rather densely hairy over the whole surface to glabrous proximally and thinly or sometimes only minutely strigulose at apex with white or sometimes a few black hairs. I agree with James (1951, p. 68) that *H. compactus* represents no more than a point on a fully documented scale of variation.

A notably unusual form of *A. didymocarpus* with deeply campanulate calyx and teeth up to 2 mm. long (more or less equaling the banner) was described as var. *daleoides* Barneby from specimens collected near Cholame and San Miguel in San Luis Obispo County. Both gatherings from Cholame were mixed with typical var. *didymocarpus*, and I have had growing doubts as

to whether the proposition was entitled to more than passing notice as a minor variant. The name is listed here for the present as a doubtful synonym of var. *didymocarpus*, pending confirmation or rejection after study of more material.

360b *ASTRAGALUS DIDYMOCARPUS* var. *MILESIANUS*

Closely resembling var. *didymocarpus* except for the larger flowers, the racemes at full anthesis (10) 12–15 mm. in diameter; stems mostly erect, coarse or sometimes quite slender; leaflets (9) 11–15; calyx at anthesis (3.5) 4–5.7 mm. long, the tube (2.5) 3–3.8 mm. long, 1.8–2.4 mm. in diameter, the teeth 1–2.4 mm. long, the ventral pair broadest and often longest; banner oblanceolate, 7.5–10 mm. long, 3.4–4 mm. wide; wings 5.8–8 mm. long, the claws (2.5) 3.3–4.1 mm., the blades 4.2–5 mm. long, 1.3–1.8 mm. wide; keel (4.7) 5.3–6.9 mm. long, the claws (2.6) 3–3.7 mm., the blades 2.5–3.6 mm. long, 1.5–1.8 mm. wide, incurved through $\pm 110^\circ$ to the broadly rounded apex; anthers (0.25) 0.3–0.4 mm. long; pod ± 3.5 –4 mm. long, glabrous or distally pilosulous.—Collections: 10 (o); representative: *J. H. Barber* (from Morro) in 1899 (UC); *Belshaw* 1740 (UC); *Elmer* 3838 (CAS, NY, ORE, UC).

Grassy hillsides and meadows along and near the ocean, mostly below 200 feet, apparently quite local, known only from southern San Luis Obispo and western Santa Barbara Counties, California.—Map No. 160.—March to May.

ASTRAGALUS DIDYMOCARPUS var. *MILESIANUS* (Rydb.) Jeps., Fl. Calif. 2: 376. 1936, based on *Hesperastragalus Milesianus* (the collector) Rydb. in Bull. Torr. Club 53: 169. 1926.—“Type collected at San Luis Obispo, California, April 1886, *M. M. Miles*.”—Holotypus, NY!

The var. *Milesianus* apparently replaces var. *didymocarpus* in the coastal region from Gaviota and Lompoc north to Cayucos. Its extreme phase is found only around San Luis Obispo and Morro, where the plants are immediately distinguished from var. *didymocarpus* by their thick spikes of comparatively handsome and brightly colored flowers. The variety was recognized independently by Rydberg and Jepson, who annotated the Barber specimen cited (UC) with an unpublished name. The material from Santa Barbara County is less well marked but has flowers substantially larger than coastal and insular var. *didymocarpus* from farther south.

The variety was collected first in 1832, between San Miguel and Santa Barbara, by Thomas Coulter (No. 440, K).

360c. *ASTRAGALUS DIDYMOCARPUS* var. *DISPERMUS*

Herbage greenish-cinereous or canescent, the vestiture commonly denser than in var. a, but the leaflets usually glabrescent medially above; stems diffuse, weakly ascending, or prostrate, (1.5) 4–27 cm. long, usually numerous and forming loosely woven mats, rarely few or solitary; leaves 1–3.5 cm. long, with (7) 9–15 (17), mostly 11–13 leaflets 2–8 mm. long; racemes 7–20-flowered, 7–9 mm. in diameter at full anthesis, the axis 3–12 mm. long in fruit; calyx (3) 3.4–4.7 mm. long, densely villous-pilosulous with white and not uncommonly (the teeth especially) some black hairs up to (0.55) 0.6–1 (1.1) mm. long, the tube 1.7–2.3 mm. long, 1.4–1.9 mm. in diameter, the subulate or subulate-setaceous teeth (1.3) 1.6–2.4 mm. long; banner (3.4) 4.3–5.4 mm. long, 1.6–2.8 mm. wide; wings (3.3) 3.9–5 mm. long, the claws (1.3) 1.7–2.4 mm., the blades 2.3–3.3 mm. long, 0.7–1.1 mm. wide; keel (3.4) 3.8–4.5 mm. long, the claws (1.4) 1.7–2.4 mm., the half-obovate blades 2–2.5 (2.8) mm. long, 1–1.4 mm. wide, abruptly incurved through 90–95° to the blunt, deltoid, or sometimes sharply deltoid and obscurely porrect apex; anthers 0.15–0.25 (0.3) mm. long; pod 2.3–4 mm. long, 1.6–2.5 mm. in diameter, densely to quite thinly strigulose-hirsutulous.—Collections: 23 (v); representative: *C. B. Wolf* 6486 (TEX, WS), 8430 (NY, WS), 10,323 (CAS, NY, TEX, WS); *C. L. Hitchcock* 6140 (NY, WS); *Eastwood & Howell* 8817 (CAS, WS); *Munz* 13,791 (POM, WS).

Open sandy flats and gravelly washes in the foothills of desert mountains,

commonly with *Larrea*, 100–3000 (3550) feet, widespread and locally plentiful in the southwestern Mohave, Colorado, and Gila Deserts, southeastern California, southwestern Arizona, and adjoining Sonora, extending south in interior Baja California to about 30° N.; apparently isolated, at 4000 feet, in the far eastern Mohave Desert (near Kingston Peak).—Map No. 160.—February to May.

ASTRAGALUS DIDYMOCARPUS var. *DISPERMUS* (Gray) Jeps., Fl. Calif. 2: 376. 1936, based on *A. dispersus* (2-seeded) Gray in Proc. Amer. Acad. 13: 365. 1878.—“Wickenburg, Arizona, Dr. Palmer, 1876.”—Holotypus, GH! isotypus, K!—*Hesperastragalus dispersus* (Gray) A. Heller, Muhlenbergia 1: 137. 1906.

Astragalus dispersus var. *albus* (white, of the calyx-hairs) L. E. James in Contrib. Dudl. Herb. 4: 68. 1951.—“Type in the Dudley Herbarium, no. 280,492, collected on the Mojave Desert, north side of Mojave River, 1½ miles from Daggett on road to Yermo, May 4, 1932, Wolf 3370.”—Holotypus, DS!

The var. *dispersus* is the form of the two-seeded milk-vetch most prevalent in the southern Mohave Desert, where its range overlaps that of var. *didymocarpus*, and it is the sole representative of its species in the torrid, low-lying Colorado and Gila Deserts. It differs from var. *didymocarpus* chiefly in its denser and whiter vesture of slightly longer hairs, and especially in its longer, narrowly subulate or subsetaceous calyx-teeth. In habit of growth the plants are commonly prostrate, varying, according to season, from diminutive examples composed of about three stems a few centimeters long to freely branched and loosely woven mats up to five decimeters in diameter. Even on the deserts, however, the vesture is somewhat variable in density, and James (l.c.) has sorted these plants into two varietal categories, accepting a typical *A. dispersus* with greenish leaves and some black hairs on the calyx-teeth, and a var. *albus* with white herbage and no black hairs. To the former she referred some specimens from cismontane California which I have identified (in duplicate) as var. *didymocarpus*, one collection of var. *obispensis*, and the synonym *Hesperastragalus Milesianus*, thus extending the range of *A. dispersus* far northwest into coastal San Luis Obispo County. Obviously our interpretations of the material are so different that no valid comparison of the present var. *dispersus* with either of James's varieties can be made. I must look with skepticism born of long experience on any proposition in *Astragalus* defined in terms of color or density of pubescence.

360d. *ASTRAGALUS DIDYMOCARPUS* var. *OBISPENSIS*

Herbage greenish-cinereous or subcanescent, the leaflets glabrous or medially glabrescent above; *stems* (1) 3–several, ascending or diffuse, (2.5) 3–25 cm. long, commonly rather robust, sometimes quite slender; *leaves* 1–5.5 cm. long, with 9–17 leaflets 1.5–10 mm. long; *racemes* (5) 8–30-flowered, the heads 8–13 mm. in diameter at full anthesis, the axis 2–20 mm. long in fruit; *calyx* 3.2–5.1 mm. long, densely villosulous with largely white or with mixed black and white hairs up to 0.7–1 mm. long, the tube 2.1–2.8 mm. long, (1.5) 1.7–2.1 mm. in diameter, the subulate-setaceous teeth (0.9) 1.1–2.5 mm. long; *banner* obovate-cuneate, (6.2) 7–8.6 mm. long, 2.5–5 mm. wide; *wings* (5.2) 5.8–7.1 mm. long, the claws 2.2–2.9 mm., the blades (3.2) 3.6–5 mm. long, 1.1–1.7 mm. wide; *keel* (5.2) 5.5–7.2 mm. long, the claws 2.4–3.2 mm., the lunately half-elliptic blades 2.9–4.2 mm. long, 1.2–1.8 mm. wide, incurved through 55–90° to the narrowly triangular, slightly porrect, acute or subacute apex; *anthers* (0.2) 0.25–0.4 mm. long; *pod* as in var. *didymocarpus*, sparsely hispidulous throughout or distally.—Collections: 18 (i); representative: *C. B. Wolf* 6301 (CAS, TEX, WS); *Munz* 5096 (POM, UC); *Jepson* 13,745 (UC); *Eastwood* 2601 (CAS, NY), 9395 (CAS); *Orcutt* 1129 (NY); *Wiggins* 9890 (DS).

Dry grassy hills, valley floors, openings in chaparral, 1400–3100 feet, locally plentiful in scattered stations in the interior cismontane valleys of southern California, extending just to the desert edge, from Antelope Valley, Los Angeles County, south to northern Baja California near Laguna Hansen and the Valley of Palms, apparently extending west to the Pacific Coast at Ensenada, but here and in the San Diego region (at lower elevations) atypical and intergradient to var.

didymocarpus; apparently isolated, at 3500 feet, near the south end of Sierra San Pedro Mártir, Baja California.—Map No. 160.—March to May.

ASTRAGALUS DIDYMOCARPUS var. OBISPENSIS (Rydb.) Jeps., Fl. Calif. 2: 376. 1936 ("*obispoensis*"), based on *Hesperastragalus obispensis* (of San Luis Obispo, an error in the original data) Rydb. in Bull. Torr. Club 53: 167. 1926.—"The type was collected at San Luis Obispo, California, May 6, 1882, Jones 3229 (in part, N. Y. Bot. Gard.). The sheet contains 3 specimens . . . The lower two specimens belong to this species . . ."—Holotypus, the two plants indicated by Rydberg, NY!—The label (Barneby 1950, p. 213) doubtless belongs with the third specimen, representing *A. Gambelianus*, as do duplicates at NY, POM (3 sheets), WS, the *obispensis* element probably introduced inadvertently.—*A. dispersmus* var. *obispensis* (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 21. 1937.

The unfortunately named var. *obispensis* can be described as a large-flowered form of var. *dispersmus*, which it resembles in its usually white- (but not infrequently partly black-) villous calyx and habit of growth. All authors (Rydberg, 1926; Jepson, 1936; James, 1951) who have listed *exsiccata* of var. *dispersmus* have included one or more examples of var. *obispensis*, which differs sufficiently in its thicker spikes of larger, often relatively highly colored and even showy flowers, and especially in its much longer keel with correctly triangular tip. Rydberg's description of the pod as glabrous is contradicted by study of the typus; no specimen with a really hairless pod has been seen. The variety is particularly well marked in its main range just west of the deserts in cismontane California, where it seems to be adapted to the arid grasslands transitional to desert conditions. The material examined from interior Baja California has for the most part slightly smaller flowers with characteristic keel-tip; but several ambiguous collections from near the coast between San Diego and Ensenada suggest passage between var. *obispensis* and var. *didymocarpus* in all critical characters.

PHALANX F

The TRIMENIAEUS ASTRAGALI

XCI. Sectio SESAMEI

Caulescent annuals; *vesture* basifixed; *stipules* free; *leaves* imparipinnate, ours with 7-13 leaflets; *racemes* subcapitate-verticillate, the flowers in ours erect, the fruits either erect or stellately ascending; *pedicels* in ours short, persistent; *calyx*-tube campanulate, shorter than the teeth; *petals* purplish, lilac, or whitish, in ours little graduated, the obtuse keel about 4.5-5.5 mm. long, nearly as long as the wings; *pod* sessile, in ours lance-oblong or narrowly oblong in profile, persistent, compressed-triangular, fully bilocular, the stiffly papery valves densely pilose-hirsute; *dehiscence* apical and downward through the ventral suture; *ovules* in ours 5-9.—Spp. about 30 (many of them critically variable and in need of revision), of the Mediterranean Basin, extending east through the Indo-Turanian deserts to India and southcentral Asia; one in the Canary Islands; one isolated in eastcentral Texas.

ASTRAGALUS sect. SESAMEI DC., Prod. 2: 287. 1825.—Sp. lectotypica: *A. sesameus* L.

Astragalus subgen. *Trimeniaeus* sect. *Oxyglottis* Bge., Astrag. Geront. 1: 10. 1868.—Sp. lectotypica: *A. oxyglottis* Stev.—*Astragalus Trimeniaei* Oxyglottides Nym., Conspect. Fl. Eur. 195. 1878.

Hamosa sect. *Wrightianae* Rydb. in N. Amer. Fl. 24: 437. 1923.—Sp. unica: *A. Wrightii* Gray.

Astragalus sect. *Oxyglottis* ser. *Submembranacei* Gontsch. in Fl. U. R. S. S. 12: 306. 1946.—Sp. lectotypica: *A. sesamoides* Bss.

The large section *Sesamei* is distinguished among the annual groups by its subverticillately capitate clusters of small flowers (either pedunculate or sessile in the leaf-axils) which give rise to a subumbellate head of erect or stellately spreading, bilocular pods variable in size, shape,

and texture, but more or less trigonously compressed and persistent (so far as I am aware) on the receptacle until dehiscence. I have made no attempt to provide a full circumscription of the section, since too many of the described species are known to me only at second hand. Our *A. Wrightii* is manifestly more nearly related to the sectional typus, *A. sesameus* L., to *A. Stella* Gouan, and to *A. sesamoides* Bss., than to any North American *Astragalus* and cannot be excluded from the *Sesamei*, however improbable the relationship may appear in the light of the geographical distribution. In practice *A. Wrightii* is easily distinguished from *A. Stella* by its much fewer leaflets, but it bears an astonishingly close resemblance to *A. sesamoides*. The latter was described from material collected by Griffith at Erak in Afghanistan and reportedly extends northwest to the Pamirs and Tian-Shan. Described at length by Gontscharov and Popov in the Soviet Flora, and illustrated by specimens distributed as *Nos. 17a and 17b* of Herb. Fl. As. Med., Fasc. 1 (NY), it appears to differ from *A. Wrightii* as follows:

1. Hairs of the herbage up to 0.6–0.9 mm. long, filiform; *leaflets* mostly 11–15, obtuse or emarginate; *banner* narrowly lance-elliptic, $\pm$ 2 mm. wide; *keel* $\pm$ 1 mm. shorter than the wings, $\pm$ 2 mm. shorter than the banner; *pod* papery, mostly 12–20 mm. long *A. sesamoides*
1. Hairs of the herbage up to 1–1.6 mm. long, slightly thickened or bulbous at base; *leaflets* 7–13, acute in all but some lower leaves; *banner* broadly oblanceolate or obovate-cuneate, $\pm$ 3–3.5 mm. wide; *keel* less than 1 mm. shorter than the banner, $\pm$ equaling the wings; *pod* stiffly papery, 7–13 mm. long *A. Wrightii*

I was able to discuss the relationship of *A. Wrightii* to *A. sesamoides* with the late Dr. Širjaev, an acknowledged authority on the annual *Astragali* of the Old World, who suggested that in addition to the differential characters noted above, the seeds of the two species differed in color and sculpturing; but I have had no opportunity to check this point.

The existence in Texas of a member of sect. *Sesamei* is bound to excite speculation as to its origin and to arouse doubts as to its native status. We can only be sure that by the middle of the nineteenth century it was already established near Austin (*Charles Wright*), a settlement at that time only twenty years old, and near New Braunfels (*Ferdinand Lindheimer*, three collections in 1849), some fifty miles to the southwest. In recent years *A. Wrightii* has been found occasionally as a weedy colonizer of disturbed soil along roadsides (Bell County, vidi), but it is equally at home and vigorous in climax associations of native species (Travis and Bexar Counties!). While we might reasonably expect an actively aggressive and perhaps discontinuous range-extension of an annual weed (and we do have one recent record of *A. Wrightii* introduced in railroad gravels near Palestine in Anderson County), the main range of *A. Wrightii* is compact and conforms to a recognizably natural pattern. Most importantly, the species has not been recognized in the Old World. Granted for the sake of argument that *A. Wrightii* is spontaneous in Texas, its situation is not unique. Floristic relationships between the Mediterranean Basin and the Near East on the one hand and southwestern United States and northern Mexico on the other, although not often emphasized in the literature, are fairly numerous. It must suffice to cite such examples as the antirrhinoid *Scrophulariaceae*, and the genera *Fagonia*, *Omphalodes*, *Erodium*, and *Lavatera*. Contemporary geologists dismiss the possibility of a recent transatlantic land-bridge, without which it is so difficult to explain the bicentric dispersal of these groups of organisms adapted to climates of Mediterranean and desert type. This problem is one of many tantalizing enigmas of plant geography.

It is generally conceded that the annual life-span is derived from the perennial, often under the pressure of arid climate, and this is borne out by study of the annual *Astragali* of North America. These fall into several groups, each clearly related to a perennial one, and presumably have evolved at a comparatively recent date. *Astragalus Wrightii*, greatly isolated in our flora, is an exception. If truly an indigenous member of sect. *Sesamei* (and its relationship, at least, cannot be disputed) it projects the acquisition of an annual life-cycle by the forebears of the section into an incalculably remote past, and has an important bearing on the history and, consequently, on the phylogeny and classification of the subgen. *Trimeniaeus* in the Old World.

361. ASTRAGALUS WRIGHTII

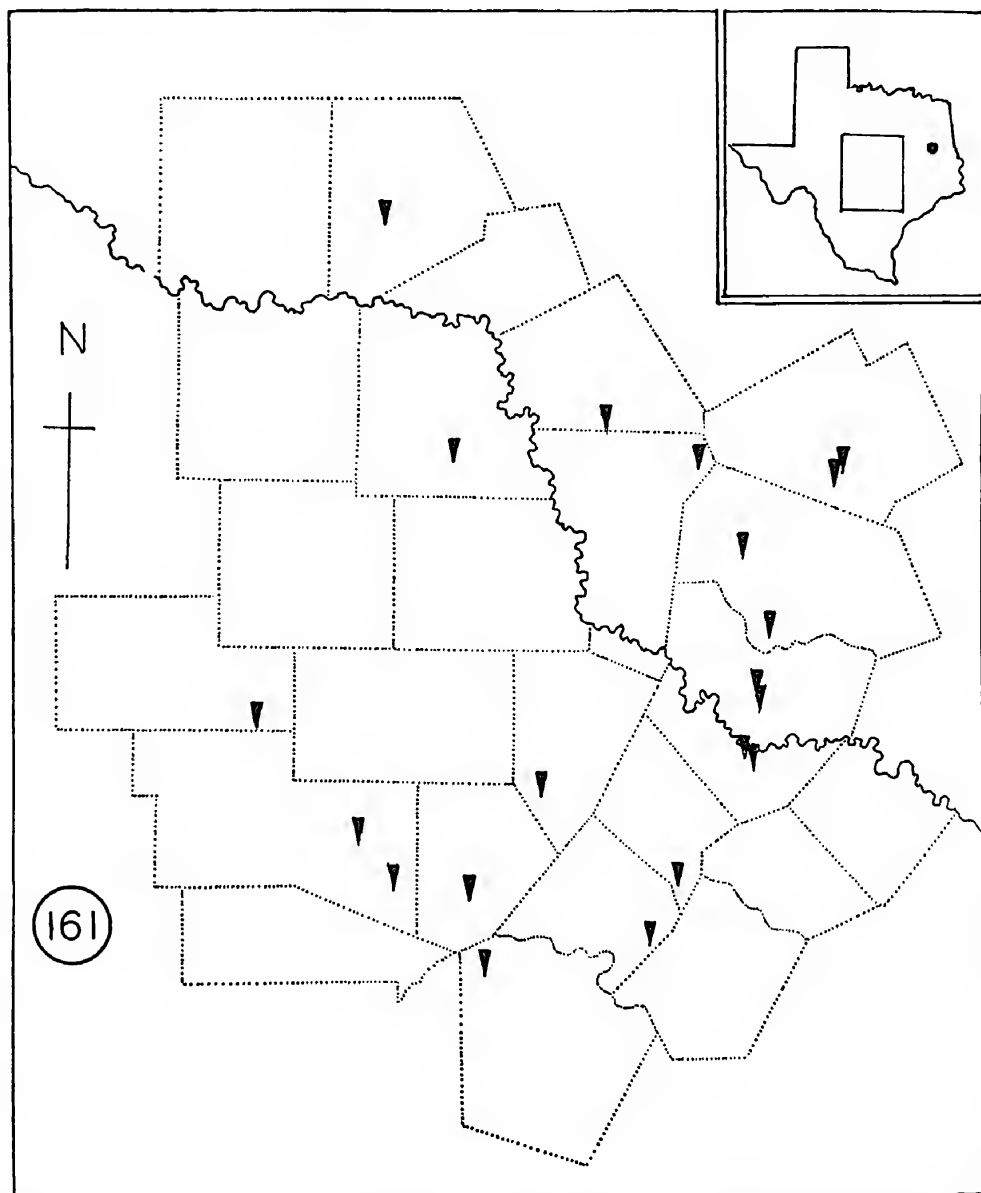
Slender but ultimately stiff or rigid annual, with a filiform taproot, silky-pilose throughout with fine, mostly straight, narrowly or loosely ascending, basally thickened hairs up to 1–1.6 mm. long, the herbage silvery-cinereous or -canescent in youth becoming greenish, the leaflets pubescent on both sides but often more thinly so above; *stems* either solitary, simple, and erect, or branched at or near the base and then 1–5, the lateral ones either erect or incurved-ascending, at maturity (2) 4–30 (35) cm. long, composed of $\pm$ 4–7 developed internodes, those succeeding

the first of the 1–4 peduncles often much shorter than the lower ones, the inflorescence then appearing subterminal or falsely corymbose; *stipules* herbaceous becoming papery, lanceolate or triangular-acuminate, 3–6 mm. long, semi- to nearly fully amplexicaul, the margins pilose-ciliate and sometimes beset with a few minute clavate processes; *leaves* 1.5–5.5 (7.5) cm. long, the lower and median petioled, the upper subsessile, with 7–13 broadly to narrowly elliptic or oblanceolate, acute, or (in some early leaves) obovate and obtuse, flat or loosely folded leaflets (2) 4–17 (20) mm. long; *peduncles* erect and stiffly ascending, 0.7–7 cm. long, the first usually, and sometimes all, longer than the leaf, the uppermost often, rarely all, shorter; *racemes* capitately 3–7-flowered, the flowers suberect, the fruits erect or, when relatively many, stellately ascending, the axis not over 4 mm. long in fruit; *bracts* herbaceous, lanceolate, 1.5–5.5 mm. long; *pedicels* at anthesis subobsolete, in fruit thickened and up to 0.6–1 mm. long; *bracteoles* 0; *calyx* 5.2–6.2 mm. long, pilose like the herbage with white hairs, the subsymmetric disc 0.7–1 mm. deep, the turbinate-campanulate, pallid tube 2–2.6 mm. long, 2.1–2.6 mm. in diameter, the linear-lanceolate, herbaceous teeth 3.2–3.8 mm. long, the whole a trifle accrescent in fruit and the teeth then up to 5.5 mm. long, in age becoming papery, ruptured, marcescent; *petals* reddish-violet, lilac, or whitish faintly lilac-tinged, the color evanescent in drying; *banner* recurved through $\pm 30^\circ$, broadly oblanceolate or obovate-cuneate, shallowly notched, 5.2–6.2 mm. long, 3.2–3.5 mm. wide; *wings* 4.7–5.5 mm. long, the claws 1.9–2.3 mm., the oblong, obtuse, nearly straight blades 3.1–3.6 mm. long, 1.1–1.4 mm. wide; *keel* (a trifle shorter or longer than the wings) 4.7–5.5 mm. long, the claws 2.1–2.6 mm., the half-obovate blades 2.8–3.2 mm. long, 1.5–1.7 mm. wide, gently incurved through $70\text{--}80^\circ$ to the blunt triangular apex; *anthers* 0.2–0.3 mm. long; *pod* erect, sessile on and firmly attached to the receptacle, oblong or lance-oblong in profile, 7–13 mm. long, 2.5–3.5 mm. in diameter, straight or nearly so, truncate or broadly rounded at base, abruptly contracted at apex into a short, subulate, decurved beak, bluntly compressed-triquetrous, the ventral angle broad and obtuse, the lateral faces low-convex, the dorsal face narrowly sulcate, the green, scarcely fleshy valves becoming brown or ultimately blackish, stiffly papery, transversely reticulate, loosely and densely pilose-hirsute, inflexed as a complete septum 1.2–2.2 mm. wide; *dehiscence* apical and downward through the ventral suture, the beak gaping to release the seeds, the dorsal suture finally splitting to expose the separating walls of the septum; *ovules* 5–9, commonly 8; *seeds* brown or yellowish-brown, often purple-speckled, lustrous but closely and irregularly pitted and wrinkled, 1.8–2.4 mm. long.—Collections: 28 (v); representative: *J. Reverchon* 1518 (NY, SMU); *Wright* 139 (BM, G, K, OXF); *Heller* 1633 (NY, SMU); *Lindheimer* 749, 749a, 749b (NY, TEX); *Ripley & Barneby* 11,062 (CAS, NY, RSA), 11,070 (CAS, RSA).

Openings in live oak and juniper woodland, gravelly hilltops and stony outcrops on prairies, 500–1000 feet, apparently confined to calcareous sqils, locally abundant in southcentral Texas, in a roughly circular area of about 150 miles diameter circumscribed to the south and southeast by the Balcones Escarpment, extending northwest into eastern Kimble County, and north into Brown and Bell Counties; lately introduced along the railroad near Palestine, Anderson County (not mapped).—Map No. 161.—March to May.

ASTRAGALUS WRIGHTII (Charles Wright, 1811–1885, pioneer botanical collector in the Southwest) Gray in Boston Jour. Nat. Hist. 6 (Pl. Lindh. 2): 176. 1850.—“Texas, near Austin, Mr. Charles Wright . . .”; also cultivated in Cambridge Bot. Gard.—Holotypus, collected in the spring of 1848, GH! isotypi, mounted with plants grown at Harvard, NY, PH! *Tragacantha Wrightii* (Gray) O. Kze., Rev. Gen. 949. 1891. *Hamosa Wrightii* (Gray) Rydb. in N. Amer. Fl. 24: 437. 1929.

The Wright milk-vetch is an inconspicuous, somewhat weedy plant, an object of botanical curiosity rather than one of beauty. Its extra-American relationships have been discussed above. In Texas it is easily recognized among the annual species by its headlike racemes of few, tiny flowers, with poorly graduated, reddish-violet to whitish-lilac petals scarcely longer than the elongate, plumose calyx-teeth, and by the erect, narrowly oblong, bluntly trigonous pods, pilose like the herbage with ascending hairs. At first weak and pliant, the stems early become rigid, a feature common to some European *Sesamei*, and are so durable that one may sometimes chance upon the skeletal remains of a plant of the preceding year, with weathered, empty pods still attached, among the green colonies of the new generation. Like many annuals, *A. Wrightii* shows a marked response to seasonal variations in rainfall; flowering, when starved, at a height of a few centimeters, becoming quite rank and up to three decimeters or more in favorable years.



Map No. 161. Parts of central Texas (cf. insert, top right, for orientation and (dot) site of an introduction. Range of *A. Wrightii*.

PHALANX G

The OROPHACA ASTRAGALI

The diagnostic syndrome which distinguishes the *Orophaca* phalanx from other groups of *Astragalus* consists of a copious silvery vesture of long, dolabriform hairs, palmately trifoliolate leaves composed of sessile leaflets disjuncting in age, a small ovoid or lance-ovoid, unilocular pod finally deciduous from the receptacle, and very large, hyaline stipules united opposite the petiole and often also behind it into a more or less loosely invaginating membrane. Stipules similar in form and texture are found in some species of *Oxytropis*, but are there combined with quite different flowers and fruits. The group has no really close relative in America, and the caespitose Asiatic species of sect. *Trachycercis* (cf. *A. Alberti* Bge., *A. orophacoides* Freyn) seem to be only superficially similar. The orophacas are readily divisible into two sections. In the typical one the plant is strictly acaulescent and the long, narrow flowers appear one or two together in the leaf-axils; the calyx is cylindric and the banner-blade is only slightly bent back from the vertical. In the *Sericoleuci* a definite stem is often (though not always) developed, and the two to six, much shorter flowers with a campanulate calyx-tube and abruptly reflexed banner are normally elevated out of the leaf-axil on a common peduncle (this sometimes concealed by the stipules). The *Sericoleuci* were referred by Jones (1923, p. 83) to a heterogeneous sect. *Homalobi*, and the genuine orophacas to a sect. *Triphylli* supposedly (op. cit. p. 86) "much nearer related to the *Ocreati*." Although it seems unnatural to separate the two groups so widely, especially since the discovery of the somewhat intermediate *A. Barrii*, Jones's arrangement does serve to emphasize the differences between the two sections. The two sorts of *Orophaca* have otherwise been treated traditionally as forming a single group, in the first instance a (doubtful) section of *Phaca*, on account of the unilocular fruit, and subsequently either a section of *Astragalus* (Gray, 1864, p. 231) or an allied genus. Gray described the leaves of *A. gilviflorus* as sometimes pinnately quinquefoliolate, but of this I have seen only a single instance (*Bourgeau in 1858*, GH), in which either one or two leaflets in a few exterior leaves arise at a point on the leaf-stalk just below the terminal trefoil. Although the trifoliolate leaf of *Orophaca* presumably arose by reduction from a primordial pinnate leaf, the Bourgeau specimen must be regarded as an isolated abnormality rather than as evidence of reversion to a more primitive astragaline type.

XCII. Sectio SERICOLEUCI

Caulescent, prostrate and matted, or acaulescent and tufted or pulvinate perennials with thick taproots and at length ramifying caudices; *vesture* dolabriform, silvery; *stipules* large, hyaline, connate-sheathing; *leaves* palmately trifoliolate; *flowers* 2-6, loosely or subumbellately racemose, the peduncles exserted or included in the stipular sheath; *calyx-tube* campanulate (in *A. Barrii* deeply so); *petals* purple or purplish, exceptionally white, regularly graduated, the banner ($\pm$ 5-16.5 mm. long, recurved through 40-90°, the keel-tip rounded or subacutely triangular; *pod* ascending or sometimes recurved on arched, slender, and usually deciduous pedicels, sessile, disjuncting from the receptacle, lance- or ovoid-ellipsoid, invested by the calyx or partly exserted, unilocular, the valves papery; *dehiscence* (seldom observed) apparently primarily basal, after falling, and upward through the ventral

suture; *ovules* 6–12.—Spp. 4, xerophytes, of badlands, breaks, buttes, and eroded knolls on the higher plains and foothills of the Rocky Mountains in Wyoming, southeastern Montana, western South Dakota and Nebraska, and northeastern Colorado.

ASTRAGALUS sect. SERICOLEUCI, sect. nov., ab *Orophaca* (cui solo arcte affines) floribus parvulis in racemo paucifloro saepissime pedunculato dispositis, tubo calycino campanulato rarius subcylindrico, vexilloque recurvo absimiles.—Sp. typica: *A. sericoleucus* Gray.

The section *Sericoleuci* consists of four closely related species differing in habit of growth and flower-size; in two of them the stipules, at least the early ones of the year's growth-cycle, are dorsally pubescent like the leaves and stems, whereas in the other two all are glabrous and lustrous. In the first three all the petals are very strongly incurved, and the keel-tip is broadly rounded; in *A. Barrii* the banner is only moderately recurved and the keel is acutely triangular at apex. The latter species, distinguished further by its relatively large flowers and deeply campanulate or subcylindric calyx-tube, leads on to the following sect. *Orophaca*. As mentioned in my revision of the group (1956), the morphological gap between one species and the next, when arranged in order of ascending flower-size, is only a narrow one. Some botanists may prefer to consider the section as composed of a single multiracial species, but the extreme forms, *A. sericoleucus* and *A. Barrii*, are so distinct in appearance and technical detail that no useful purpose would be served by uniting them.

The fruit of the *Sericoleuci*, at best an inconspicuous little legume of simple shape and structure often largely concealed by the marcescent calyx, is seldom collected and poorly known. The pods seem to form and ripen slowly, long after the last flowers are gone; and populations of almost wholly sterile plants can be found along the Platte River in some years. Study of the fruits may provide additional specific criteria, and collectors are urged to make careful search for them from late June onward.

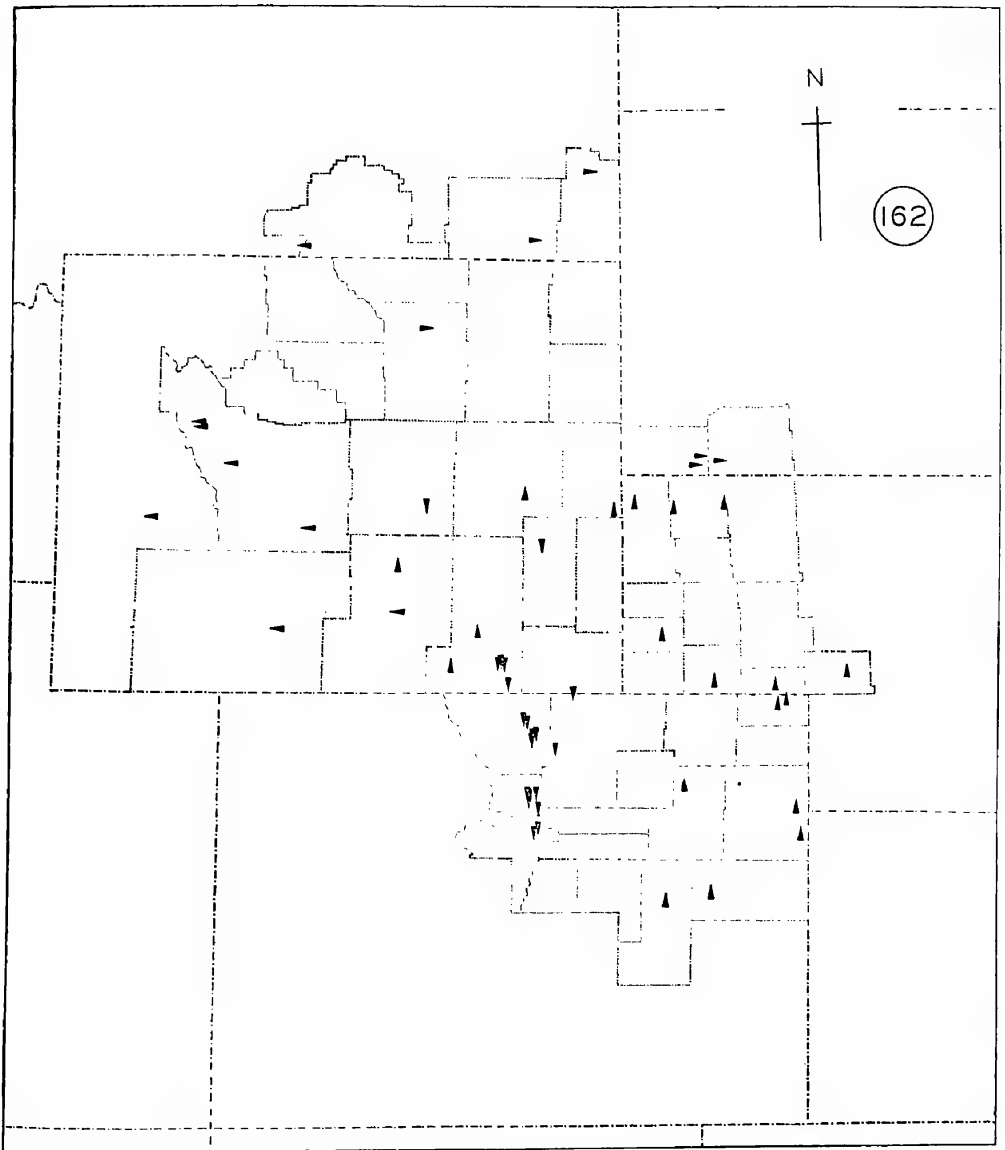
Key to the Species of Sect. *Sericoleuci*

1. Flowers very small, the calyx 2.4–4.2 mm., the banner 5.2–8 mm., the keel 4–4.5 mm. long (2)
 2. Plants prostrate, matted, the freely branching stems forming fan-shaped sprays; *stipules* densely pilose dorsally; *racemes* (2) 3–5-flowered; *banner* 5.2–6.2 mm. long; n.-e. Colorado and w. Nebraska, extending less frequently up the Platte and Laramie Rivers into s.-e. Wyoming 362. *A. sericoleucus*
 2. Plants densely pulvinate, mounded; *stipules* glabrous or nearly so dorsally, ciliate; *racemes* nearly all 2-flowered; *banner* (5.8) 6.6–8 mm. long; upper forks and tributaries of the North Platte and valley of the Wind and Big Horn Rivers, Wyoming and extreme s. Montana, w. in Wyoming to the Green River drainage in the Red Desert 363. *A. aretioides*
1. Flowers larger, the calyx 4.5–7.1 mm., the banner 8.3–16.5 mm., the keel 5.3–10.5 mm. long (3)
 3. Petals all strongly recurved, the keel through 90–100° to the rounded apex; *banner* 8.3–11.5 mm., keel 4.4–7.2 mm. long; *calyx-tube* campanulate or turbinate, 1.8–3.5 (3.8) mm. long; *stipules* (at least the lower ones) pilose dorsally; *anthers* 0.3–0.55 mm. long; foothills of the Front Range, Colorado, n.-ward from Denver to the Laramie Plains, and locally n.-ward along the North Platte from Casper downstream 364. *A. tridactylicus*
 3. Petals less strongly recurved, the keel through ± 60–85° to the sharply triangular apex; *banner* (9.6) 10.5–16.7 mm., keel 7.5–10.5 mm. long; *calyx-tube* deeply campanulate or subcylindric, 3.6–5.1 mm. long; *stipules* glabrous dorsally; *anthers* (0.45) 0.5–0.75 mm. long; extreme s.-w. South Dakota, n.-w. to the Powder River drainage in n.-e. Wyoming and extreme s.-e. Montana 365. *A. Barrii*

362. ASTRAGALUS SERICOLEUCUS

Distinctly caulescent, prostrate, the freely branching stems radiating from the crown of a thick taproot and forming mats 1.5–9 dm. in diameter, the caudex-branches beset with a thatch of flaccid, persistent petioles, the herbage silvery-pilose with fine, lustrous, appressed and narrowly ascending hairs up to 3 mm. long or more; *stems* of the year very short or (especially the outermost of a mat) up to 5 cm. long or more; *stipules* 2–8 mm. long, hyaline, densely pilose dorsally, united behind the petiole and connate-amplexicaul; *leaves* 1–4 cm. long, the 3 narrowly

to broadly oblanceolate, rarely obovate-cuneate, subacute leaflets 3–13 mm. long; *peduncles* 0.5–2.5 cm. long; *racemes* loosely (2) 3–5-flowered, the flowers ascending, the axis up to 1 cm. long in fruit; *bracts* membranous, lanceolate 1–2.5 mm. long; *pedicels* slender, at anthesis 1–1.5 mm., in fruit 1.5–3.5 mm. long; *petals* pink-purple with a pale lozenge in the fold of the banner, often drying yellowish, rarely pure white; *banner* recurved through nearly 90°, obovate-cuneate, 5.2–6.2 mm. long, 3.8–4.2 mm. wide; *wings* 5–5.8 mm. long, the claws 2–2.4 mm., the broadly oblanceolate, lunately incurved blades 3.2–4 mm. long, 1.3–1.7 mm. wide; *keel* 4–4.5 mm. long, the claws 1.9–2.3 mm., the half-obovate blades 2.2–2.7 mm. long, 1.4–1.7 mm. wide, incurved through 90–100° to the bluntly deltoid apex; *anthers* 0.3–0.4 (0.45) mm. long; *pod* ascending or recurved from arched pedicels,



Map No. 162. Wyoming, Colorado, and parts of adjoining states. Range of $\blacktriangledown$ *A. tridactylus*; of $\blacklozenge$ *A. Barrii*; of $\blacktriangle$ *A. sericoleucus*; and of $\blacklozenge$ *A. aretioides*.

sessile, $\pm$ 5.5–7 mm. long, the ovoid-ellipsoid, slightly compressed body 3–4.5 mm. long, $\pm$ 2 mm. in diameter, commonly included in the unbroken calyx, tapering distally into a narrowly tubular, incurved beak nearly as long, the thin, densely silky-strigose or -pilose valves becoming papery, not inflexed; *ovules* 6–10; *seeds* (seldom seen) olive-brown, smooth, about 1.3–1.5 mm. long.—Collections: 20 (v); representative: *Brenkle* 43,101 (NY, SMU); *A. & E. Nelson* 6828 (NY); *W. A. Weber* 6040 (CAS, SMU); *C. L. Porter* 7262 (NY); *Ripley & Barneby* 9096 (CAS, RSA), 9126 (CAS, NY, RSA), 10,571 (RSA).

Barren ridges, knolls and hilltops, in gravelly clays and among disintegrating rocks, especially on shale outcrops, locally plentiful on the higher prairies between 3800 and 5300 feet from northeastern and eastcentral Colorado to western Nebraska and adjoining Wyoming, and extending west in scattered stations up the Platte and Little Laramie Rivers to the Seminoe Mountains in Carbon County and the base of the Snowy Mountains in Albany County, Wyoming—Map No. 162.—Late May to July.

ASTRAGALUS SERICOLEUCUS (white-silky) Gray in Amer. Jour. Sci. II, 33: 410. 1862, based on *Phaca sericea* (silky) Nutt. ex T. & G., Fl. N. Amer. 1: 343. 1838 (non *A. sericeus* DC., 1802).—"On the high hills of the Platte near the Rocky Mountains . . . Nuttall."—Holotypus, labeled in Nuttall's hand: "*Phaca *sericea*. R. Mts.-Platte," BM! isotypi, K, NY!—*Tragacantha sericea* (Nutt.) O. Kze., Rev. Gen. 942. 1891. *Orophaca sericea* (Nutt.) Britt. in Britt. & Br., Ill. Fl. 2: 307, fig. 2155. 1897.

The silky orophaca, *A. sericoleucus*, is an attractive little plant at all stages of growth, as much for its closely woven mats of silvery three-fingered foliage as for the lavender- or rosy-purple flowers which although very small are sometimes produced in sufficient numbers to make patches of color visible from a distance. The flowers, however, are usually of pale or muted tones and never contrive the display afforded by *A. tridactylus* on the red beds of the Laramie Hills or by *A. aretioides* on the Wind River. The species is commonest and most abundant locally on the short-grass prairies of western Nebraska and northeastern Colorado, where it is the only known member of its section; but it follows the North Platte westward to the mouth of the Sweetwater and has been traced up the Little Laramie River nearly to Centennial. There its range overlaps that of the mat-forming phase of the much larger-flowered *A. tridactylus*. In southeastern Wyoming flowers, or at least the marcescent calyces, are required for positive identification. According to Rydberg (Fl. Neb.) *A. sericoleucus* extends north into South Dakota, but I have seen no specimens validating the claim. The record was dropped from Rydberg's summary revision (1929, p. 311); and Claude Barr, long resident near Smithwick in southeastern Fall River County, tells me (in correspondence) that it is unknown from that corner of the state, where its place is taken by the very different, calciphile rather than shale-dwelling *A. Barrii*.

Besides the typus already cited, three Nuttall collections at PH deserve passing notice. The sheet bearing the same label as at NY consists of a mixture of *A. sericoleucus* and *A. aretioides*, which Nuttall evidently confounded; for the purpose of typification the element of the second species should be ignored. A second sheet of material belonging to *A. sericoleucus*, but possibly representing a separate collection, is ticketed by Nuttall as: "*Phaca *trifoliata*. Platte (R. Mts.)." The name was never published.

363. *ASTRAGALUS ARETIOIDES*

Technically similar to *A. sericoleucus*, but pulvinate, the very short stems of the year and the young foliage elevated on repeatedly and closely forking, columnar caudex-branches to form mounded cushions 1–3 dm. in diameter, the herbage commonly more densely silky, satiny-lustrous when young, the longest hairs scarcely over 2 mm. long; *stems* of the year almost 0 or up to 1.5 cm. long, the internodes mostly concealed by dorsally glabrous (or subglabrous), ciliate stipules; *leaves* crowded, 1–2 cm. long, the leaflets 3–6 mm. long; *peduncles* ascending, 7–15 mm. long; *racemes* 2-flowered; *calyx* 3.3–4.2 mm. long, the tube 2.1–2.3 mm., the teeth 1.2–2 mm. long; *petals* brilliant pink- or magenta-purple to blue- or reddish-violet, rarely white; *banner* (5.8) 6.6–8 mm. long, 4–5.3 mm. wide; *wings* (5.7) 6–6.8 mm. long, the claws 1.7–2.1 mm., the blades 4.3–5.1 mm. long, 1.4–2.1

mm. wide; *keel* 4.1–4.5 mm. long, the claws 1.8–2.2 mm., the blades 2.5–2.9 mm. long, 1.4–1.7 mm. wide; *anthers* 0.3–0.4 mm. long; *pod* $\pm$ 4–4.5 mm. long, not seen fully formed, apparently similar to that of the preceding.—Collections: 11 (iii); representative: *A. Nelson* 4767 (NY, RM); *Merrill & Wilcox* 613 (NY, RM); *Ripley & Barneby* 7977 (CAS, RSA), 8920 (CAS, RSA, UTC); *E. & L. Payson* 2601 (GH, MO, RM).

Barren clay bluffs and eroded banks, on sandstone or limestone, 4000–5800 feet, locally plentiful along the east foothills of the Rocky Mountains in Wyoming, especially along the Wind and Big Horn Rivers, extending north along the latter stream just into Big Horn County, Montana, and south to Bitter Creek in the Red Desert (west of the Continental Divide); also in scattered stations eastward to the North Platte in Carbon County and to Sand Creek in Albany County.—Map No. 162.—June to August.

ASTRAGALUS ARETIOIDES (Jones) Barneby in Amer. Midl. Nat. 55: 505. 1956, based on *A. sericoleucus* var. *aretioides* (in habit resembling an Aretian *Androsace*) Jones, Contrib. West. Bot. 8: 13. 1898.—“H. Engelmann, Simpson’s Exp. Aug. 19, 1858, mountains near Sweetwater River, Wyo. This is the type.”—Holotypus, MO!—*Orophaca aretioides* (Jones) Rydb. in Bull. Torr. Club 32: 655. 1905.

The cushion orophaca, *A. aretioides*, which differs technically from *A. sericoleucus* in its pulvinate growth-habit and lustrous, dorsally glabrous stipules, is by far the showier plant at anthesis. Although the flowers are only a trifle larger, they are substantially longer in proportion to the tiny, white-satiny leaflets; being more closely set together over the mounds of foliage, they make a telling effect when all are in bloom together. In some populations of *A. aretioides* along the upper Wind River, where the species is associated in places with the similarly mounded but entire-leaved *A. simplicifolius*, the flowers vary in color from a purple ordinary in the genus into deep bluish- and amethystine-violet and through successively paler shades of lilac and pinkish-lavender into a pure albino.

As mentioned under *A. sericoleucus*, the cushion orophaca was collected first by Nuttall, but not immediately recognized as distinct. Nuttall left no record of the locality, but this might well have been on the Sweetwater River where Engelmann encountered the species not long afterward. The var. *aretioides* described by Jones in his Revision (1923, p. 84) is not the original plant, but the matted phase of *A. tridactylus* found on the red beds of the Laramie Plains. Likewise Rydberg’s *O. aretioides*, with “pubescent stipules” and a range extending into “northern Colorado,” is based largely on the same misconception.

364. ASTRAGALUS TRIDACTYLICUS

Acaulescent or shortly caulescent, the stems of the year rarely more than 1.5 cm. long, often all reduced to thick crowns terminating the divisions of a caespitose or more loosely forking (and then prostrate) caudex beset with a thatch of persistent leaf-stalks and stipules, together forming close tufts, cushions, or mats of foliage 0.5–3 (4) dm. in diameter, the herbage silvery-pilose or -silky throughout with lustrous, ascending, and subappressed (sometimes spirally twisted) hairs up to (0.75) 1–2 mm. long; *stipules* 5–10 mm. long, densely or loosely imbricated, either all pubescent dorsally or the inner ones of the shorter crowns glabrescent or subglabrous dorsally, pilose-ciliate, the ciliae sometimes mixed with minute tack-shaped processes; *leaves* 0.5–6 cm. long, either all alike or dimorphic, all or only the early ones shortly petioled and with obovate or broadly cuneate-oblongate leaflets 2–10 (13) mm. long, or the later ones (developing with or after the flowers) with slender, elongate petiole and narrowly oblongate leaflets 0.8–2 cm. long; *peduncles* varying from subobsolete to 1 cm. long, much shorter than the leaves, often concealed within the stipular sheaths; *racemes* loosely but very shortly 2–6 (acc. Rydberg up to 10)-flowered, the flowers ascending, the axis not over 5 mm. long but often produced as a subulate appendage beyond the last flower; *bracts* hyaline with firm midrib, broadly lance-elliptic to obovate, involute-boat-shaped, 1.5–5.5 mm. long; *pedicels* 1–3.5 mm. long; *calyx* 4.5–6.9 mm. long, densely sil-

very-pilose, the campanulate or turbinate campanulate tube 2.7–3.8 mm. long, 1.6–3.8 mm. in diameter, the lance-subulate teeth 1.8–3.5 mm. long; *petals* pink-purple; *banner* obovate-cuneate, 8.2–11.5 mm. long, 4.2–6 mm. wide; *wings* 7.5–11 mm. long, the claws 3–4.4 mm., the blades 4.8–7.2 mm. long, 1.6–2.2 mm. wide; *keel* 5.3–7.2 mm. long, the claws 2.8–4.4 mm., the blades 2.8–3.2 mm. long, 1.6–2.2 mm. wide, obtuse; *anthers* 0.35–0.55 mm. long; *pod* (seldom observed) apparently as in *A. sericoleucus*; *ovules* 6–12.—Collections: 30 (v); representative: *Clokey* 4174 (CAS, NY, WIS, WS, TEX); *W. A. Weber* 3268 (CAS, TEX); *Ramaley & Richards* 15,952 (CAS, TEX, WS); *Osterhout* 6225 (NY, RM), 6472 (RM, WIS); *A. Nelson* 59, 207, 4320 (NY, RM); *C. L. Porter* 3060 (NY, RM, WTU); *Ripley & Barneby* 7719 (CAS, RSA).

Bluffs, knolls, and depressions on rolling plains, in sand or gravelly clays, on shale, sandstone, and limestone, especially abundant on the red sands of the Chugwater formation, 4800–7400 feet, locally plentiful in the Rocky Mountains drained by the north and south forks of the Platte River, from near Denver, Colorado, northwest to the Laramie Plains, Wyoming, and north, becoming less common, to the North Platte near Casper.—Map No. 162.—Late May to July.

ASTRAGALUS TRIDACTYLICUS (three-fingered, of the leaves) Gray in Proc. Amer. Acad. 6: 527. 1865.—“Near Boulder City, Colorado Territory, in dense tufts or mats, on gravelly knolls, Dr. C. C. Parry, 1864.”—Holotypus, *Parry* 54, GH! isotypi, MO, NY, P, US!—*Tragacantha tridactylica* (Gray) O. Kze., Rev. Gen. 948. 1891. *A. sericoleucus* var. *tridactylicus* (Gray) Jones, Contrib. West. Bot. 10: 69. 1902. *Orophaca tridactylica* (Gray) Rydb. in Bull. Torr. Club 32: 668. 1905.

Astragalus tridactylicus fma. *coloradoensis* Gand. in Bull. Soc. Bot. France 48: xvi. 1902.—“Hab. Colorado, ad La Porte (C. Crandall).”—Holotypus, undated, LY! probable isotypus, collected by Crandall in 1895 at Fort Collins (a mile or two distant from Laporte), NY!

Astragalus tridactylicus fma. *pallidiflorus* (pale-flowered) Gand. in loc. cit. 1902 (“*pallidiflora*”).—“A. Nelson exs. no. 4430 . . . Hab. Wyoming, ad Laramie (A. Nelson).”—Holotypus, actually *A. Nelson* 4320, collected on the Laramie Hills, May 30, 1898, LY! isotypi, NY, RM!

The foothill orophaca, *A. tridactylicus*, is in some respects intermediate between the two preceding species in habit of growth, but is a coarser plant than either and has at least slightly and often substantially larger flowers. It embraces two rather marked but intergradient forms or incipient geographic varieties. The nomenclaturally typical phase, restricted to the foothills and piedmont plains between approximately five and six thousand feet from Denver north to the forks of the Cache-la-Poudre in Larimer County, Colorado, is a truly acaulescent, tufted plant with notably dimorphic leaves, those maturing with and after the inflorescence having longer leaf-stalks and longer leaflets of narrower outline than those preceding or following them. The flowers in this form tend to be large for the species and to be very shortly pedunculate, appearing radical. Only the outer ranks of imbricated stipules in the year's cycle are pubescent on the back, the inner ones concealed by them being glabrous or nearly so except for a fringe of long hairs around the margin. On the Laramie Plains in Albany County, Wyoming, at seven thousand feet or a little over, the common orophaca is technically similar but often shortly caulescent, so that mature plants form matted growths many times wider than high; its leaves are uniform or nearly so, all shortly petioled and with comparatively short and broad leaflets; its flowers are all small, either subsessile or manifestly pedunculate, and the stipules are all pubescent dorsally, the outermost densely so. These, however, are ideally conceived contrasts which do not hold good for many individual specimens. The Laramie phase has been traced north in scattered stations to the North Platte Valley in Platte and Natrona Counties, where it descends to elevations of about 4800–5200 feet. It there combines a subcaulescent habit with small flowers either radical or pedunculate. It seems impossible to admit any dismemberment of *A. tridactylicus* into named varieties.

The foothill orophaca makes a lasting impression on anyone who has seen it in full flower near Laramie, when the mats of silvery foliage, enameled over with a profusion of small, vivid purple blossoms, blaze out in the clear mountain light against their background of cinnabar-colored sand. Seen thus, *A. tridactylicus* might be coveted by the rock gardener. The species has proved difficult, however, to establish in gardens and loses its brilliance in moister, darker climes.

365. *ASTRAGALUS BARRII*

Subcaulescent, densely tufted or mounded, the stems of the year reduced to

leafy crowns elevated year by year on branches of a closely and repeatedly forking caudex beset with a thatch of marcescent stipules and recurving petioles, together forming low cushions or domes of foliage up to 5 dm. in diameter (but mostly less), silvery-strigose with straight, appressed or narrowly ascending, lustrous hairs up to 1–1.4 mm. long, the herbage canescent, the stipules glabrous dorsally, lustreously hyaline; *stipules* 4–8 mm. long, united behind the petiole and (at least in vernalion) connate opposite it into a sheath; *leaves* 1–4 (5) cm. long, slenderly petioled, the leaflets linear-oblong, oblanceolate, or in some short leaves produced in early spring elliptic-obovate, acute or subacute, mostly involute or conduplicate, 3–12 mm. long; *peduncles* slender, 7–22 mm. long, at anthesis erect, in fruit recurved-spreading or the outermost on a plant prostrate and radiating; *racemes* loosely (1) 2–4-flowered, the flowers ascending, the axis up to 0.5–1.5 cm. long in fruit; *bracts* scarious, lanceolate, linear-lanceolate, or subsetaceous, 1.8–3.5 mm. long; *pedicels* ascending, straight or nearly so, 0.7–1.5 mm. long, scarcely thickened or elongating in fruit; *calyx* (4.8) 5–7.1 mm. long, densely white-strigose, the deeply campanulate or short-cylindric tube 3.6–5.1 mm. long, 1.8–2.4 (3) mm. in diameter, the subulate or linear-subulate teeth (1.4) 1.9–5.1 mm. long, the whole becoming papery, marcescent unruptured; *petals* pink-purple with a pale, striate lozenge in the fold of the banner; *banner* recurved through $\pm 40^\circ$, obovate beyond the long-cuneate claw, or oblanceolate, shallowly notched, (9.6) 10.5–16.7 mm. long, (3.8) 4.4–8.3 mm. wide; *wings* 9.1–13.5 mm. long, the claws 4.1–5.5 mm., the linear-oblong, obtuse, or obliquely obovate and subemarginate, slightly incurved blades (4.6) 5.3–8.5 mm. long, 2.3–3.1 mm. wide; *keel* 7.5–10.5 mm. long, the claws 4.3–6 mm., the lunately half-elliptic blades 3.5–4.8 mm. long, 1.6–2.5 mm. wide, incurved through $60\text{--}85^\circ$ to the acutely triangular, often subporrect apex; *anthers* (0.45) 0.5–0.75 mm. long; *pod* ascending, sessile, narrowly lance-ellipsoid, 4.5–7.5 mm. long, 1.2–2.2 mm. in diameter, tapering distally into a slightly incurved, lance-subulate beak nearly as long as the fertile part, when fully ripe obscurely trigonous in the lower half, carinate ventrally by the suture, a little flattened dorsally, the thin, silvery-strigulose valves becoming papery, not inflexed; *dehiscence* basal and upward through both (but primarily through the ventral) sutures; *seeds* (commonly only 1 maturing) oblong-cylindroid, not or scarcely compressed, dull greenish-purple, smooth but dull, 1.9–2.1 mm. long.—Collections: 11 (i); representative: *Tweedy 3156* (NY, RM); *Barr* (from 3 localities in Fall River and Shannon Counties, South Dakota) in 1952 (RSA), 2011, 2012, 2013 (RM); *Barneby 13,231* (CAS, GH, NY, RM, RSA, US); *Schunk & Schwantz* (from Ekalaka, Montana) in 1943 (UTC).

Gullied knolls, buttes and barren hilltops, mostly below 4700 feet, on limestone or sandstone, apparently uncommon but locally plentiful, known only from the valley of the White River in southwestern South Dakota and from the Powder River drainage in northeastern Wyoming and extreme southeastern Montana.—Map No. 162.—May to June, sometimes in late April in years of light snowfall.

ASTRAGALUS BARRII (Claude Arno Barr, 1887—, proprietor of Prairie Gem Ranch, nursery near Oelrichs, South Dakota) Barneby in Amer. Midl. Nat. 55: 506. 1956.—“SOUTH DAKOTA. Limestone Butte (SE of Oelrichs), Fall River Co., May 4, 1952, Claude A. Barr.”—Holotypus, CAS!

The Barr orophaca is easily distinguished from the other *Sericoleuci* by the length of the petals and by the moderate curvature of the banner and of the triangular, not bluntly rounded blades of the keel. The allopatric *A. tridactylus* alone approaches it in flower-size, but this is ordinarily a simply tufted or matted plant never elevated into a domed cushion, and it differs technically in its dorsally pubescent stipules. The dispersal of the Barr orophaca is still imperfectly known, but it inhabits a tract of prairie country which has been neglected by botanists and from which there are few astragalus records of any kind. In South Dakota it is confined to

a limestone caprock overlying the Pierre formation and, according to Mr. Barr, is an insular relic in this region. Near Biddle, Montana, the species is found on sandstone and no reason for its extreme localization there is apparent. Nothing is known of its habitat in Wyoming. Compared with other *Sericoleuci*, which seem to fruit very sparingly and in some years not at all, *A. Barrii* is prolific with fertile pods, produced even under cultivation in the East.

XCIII. Sectio OROPHACA

Acaulescent, tufted or pulvinate, with a thickened taproot and superficial root-crown or repeatedly forking caudex; *vesture* dolabriform, silvery; *stipules* large, hyaline, united behind the petiole and shortly connate opposite it into a sheath (this sometimes ruptured in age); *leaves* trifoliolate, the sessile leaflets caducous when dried; *peduncles* obsolete, the 1–3 flowers sessile or nearly so in the leaf-axils; *calyx-tube* cylindric; *petals* white, ochroleucous, or purple, narrow and elongate, little recurved, regularly graduated, the banner $\pm$ 12.5–28 mm. long, the keel-tip bluntly triangular; *pod* ascending, sessile, at first invested by the calyx but finally rupturing the tube, deciduous from the receptacle, subsymmetrically ovoid-ellipsoid or ellipsoid, a little depressed dorsally near the base, carinate ventrally by the suture, the somewhat fleshy valves becoming leathery, not inflexed; *dehiscence* apical and downward through the dorsal suture, the valves finally gaping and twisted-recurved; *ovules* 8–17.—Spp. 3, xerophytes, of the higher prairies and foothills of the Rocky Mountains, southern Alberta and southwestern Manitoba south to Wyoming and northeastern Colorado, in Wyoming extending feebly west across the Continental Divide just into northern Utah.

ASTRAGALUS sect. OROPHACA (T. & G.), comb. nov., based on *Phaca* sect. (?) *Orophaca* T. & G., Fl. N. Amer. 1: 342. 1838.—Sp. typica: *Phaca caespitosa* Nutt. = *A. gilviflorus* Sheld.—*Orophaca* (T. & G.) Britt. in Britt. & Br., Ill. Fl. 2: 306, pro gen. 1897.

ASTRAGALUS sect. TRIPHYLLI Gray in Proc. Amer. Acad. 6: 231. 1864.—Sp. typica: *A. triphyllus* Pursh = *A. gilviflorus* Sheld.—*Astragalus* sect. *Triphyllus* Sheld. in Minn. Bot. Stud. 1: 117. 1894, a superfluous substitute.

The genuine orophacas differ from the related *Sericoleuci* in the long, narrow flower and (so far as known) in the beakless pod much shorter than the cylindric calyx-tube and of more or less fleshy, finally leathery textures. They are truly stemless plants, with three-fingered, silvery-pubescent leaflets gathered into crowns which are beset with a ruff of large, fragile, transparent stipules. According to age and species the plants vary from small, tidy tufts into mounded cushions built up by slow elongation of the caudex-branches, which become columnar from the thatch of persistent leaf-stalks and stipules impacted in wind- or water-borne sand and clay. The whitish or rarely purple flowers sit stemless among the leaves, two or three together on a vestigial peduncle, and are commonly very handsome during their short season. The ripe fruit of *A. hyalinus* is still unknown, and the sectional description may require emendation in this respect.

Key to the Species of Sect. Orophaca

1. Banner oblanceolate or spatulate-oblanceolate, tapering evenly from tip to base, not differentiated into blade and claw of subequal length and width, the whole 16–28 mm. long. Petals glabrous (the banner rarely puberulent) dorsally; *ovules* 10–17; flowering in early spring (late April and May, into early June only in the highest stations); widespread, over the whole range of the section 366. *A. gilviflorus*
1. Banner (platynychious) narrowly fiddle-shaped, differentiated into an oblanceolate blade superimposed on an oblanceolate claw of the same length and width, the whole forming an oblong-oblanceolate figure with shoulder-like projections at the middle, $\pm$ 12.5–17.5 mm. long (2)
2. Petals glabrous dorsally; *ovules* 11–14; flowering in early spring (May, at 6500–7000 ft.). Pod narrowly lance-ellipsoid, 7–10 mm. long, 2.5–3 mm. in diameter; local in extreme s. Wyoming (Sweetwater County), w. of the Continental Divide 367. *A. proimanthus*
2. Petals all villous dorsally; *ovules* 8–9; flowering in summer (June and July, not

before late June at elevations over 6500 ft.). Pod unknown, but probably shorter and plumper than in the foregoing; Wyoming e. of the Continental Divide, to n.-e. Colorado, w. Nebraska, and w. South Dakota 368. *A. hyalinus*

366. *ASTRAGALUS GILVIFLORUS*

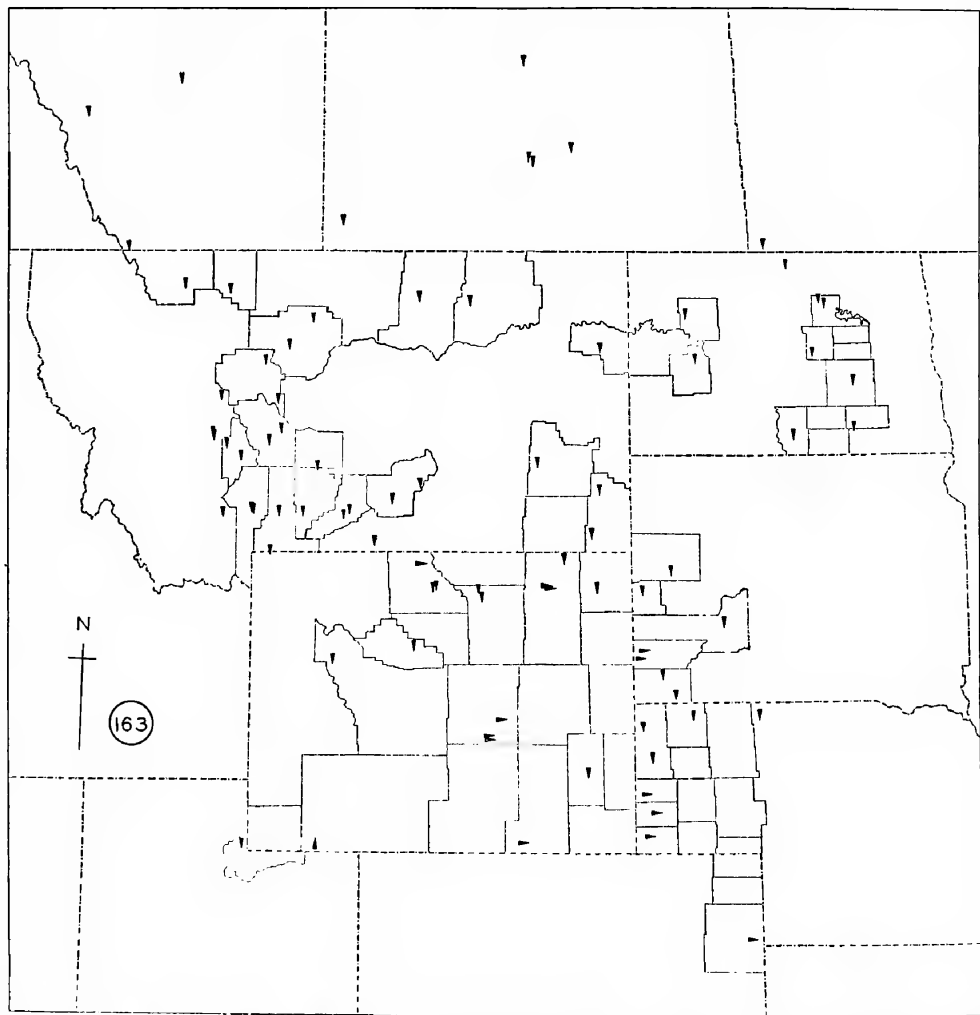
Tufted or somewhat mounded, the divisions of the closely forking, caespitose caudex beset with a thatch of persistent leaf-stalks and terminating in obconic crowns of rosulate leaves and sessile flowers, the herbage densely silvery-strigose throughout with fine, lustrous, appressed and some few narrowly ascending hairs up to 1.2–2.5 (3.6) mm. long, the hairs sometimes spreading late in the season; *stipules* broadly ovate or oblong-obovate, 6–13 mm. long, often transversely corrugated, glabrous dorsally except at base, thinly ciliate; *leaves* (1) 1.5–10 (13) cm. long, usually dimorphic, those expanding with the flowers more shortly petioled and with shorter and broader leaflets than succeeding ones, the petioles slender, wiry, subsistent, the leaflets obovate-cuneate to rhombic-obovate or narrowly oblanceolate, (3) 7–27 (37) mm. long, mostly acute or acuminate, more rarely obtuse, flat or loosely folded, dorsally carinate by the midrib, the terminal one usually a trifle longer than the lateral pair; *peduncles* obsolete or nearly so; *racemes* capitately 2 (rarely 1 or 3)-flowered, not elongating; *bracts* hyaline, lanceolate or broadly ovate-acuminate, when broad folded around the base of the calyx, 4.5–7.6 mm. long, commonly tridentate, the middle tooth often triangular-acuminate, the lateral ones shorter, either obtuse or acute, the margins entire or sharply denticulate, sometimes beset with a few minute processes; *pedicels* almost 0 up to 1.6 mm. long; *bracteoles* 0 (exceptionally a minute scale); *calyx* 9.3–20 mm. long, the subsymmetrically obconic disc 1.6–2 mm. deep, the membranous, narrowly cylindric or cylindro-ellipsoid tube 6.5–16 mm. long, 1.6–4.3 mm. in diameter, the firmer, subherbaceous teeth 1.6–4 mm. long, the whole becoming scarious, at first distended by the tumescent ovary, finally ruptured at base; *petals* commonly white (drying yellowish), the keel-tip pinkish-lilac, rarely all pink-purple or bluish, withering-persistent; *banner* nearly erect, oblanceolate or spatulate-oblanceolate, shallowly notched, 16–28 mm. long, 3–9.4 mm. wide; *wings* 12.2–24.2 mm. long, the claws 6.8–15.2 mm., the straight, narrowly oblong or oblong-oblanceolate, obtuse or obliquely emarginate blades 6–11.2 mm. long, 1.2–3.2 (3.6) mm. wide; *keel* 10.4–21.8 mm. long, the claws 6.7–15 mm., the obliquely elliptic or lunately half-elliptic blades 4–7.5 mm. long, 1.5–3 mm. wide, gently incurved through $\pm 45^\circ$ to the bluntly triangular apex; *anthers* 0.65–0.95 (1.1) mm. long; *pod* erect, sessile (often concealed by imbricated stipules), subsymmetrically ovoid-ellipsoid, (6) 6.5–10 mm. long, 2.6–5 mm. in diameter, obtuse at base, contracted at apex into a short, erect or declined cusp, the body a trifle laterally compressed, obtusely carinate ventrally by the thick suture, sometimes obscurely sulcate or flattened dorsally at or just above the base, the somewhat fleshy, densely strigose-hirsutulous valves becoming leathery, not inflexed; *seeds* ochraceous, sometimes with a purple spot at the hilum, or deep purple-black, smooth but dull, sometimes distorted by crowding, 1.6–2 mm. long.—Collections: 77 (xv); representative: *Breitung* 15,955 (NY); *Macoun & Herriott* 70,480 (ND); *C. L. Hitchcock* 15,851 (NY, RSA), 16,216 (NY, RSA, WS), 16,308 (RSA, WS); *Lunell* in 1905, 1907, 1912 (NY); *Rydberg* 635 (NY); *M. Ownbey* 558 (NY, WS, WTU); *C. L. Porter* 6873 (NY); *Ripley & Barneby* 7818 (CAS, RSA, UTC).

Barren knolls, hilltops, and gullied badlands, on limestone, shale or sandstone, mostly below 5000 feet but ascending to 7000 feet in western Wyoming, widespread and locally plentiful, especially in actively eroded sites along water courses, southern Alberta to extreme southwestern Manitoba, south through North and

South Dakota to western Nebraska, west in Montana to the upper Missouri and Madison Rivers and in Wyoming to the valleys of the North Platte and Wind Rivers; apparently isolated west of the Continental Divide in Summit County, Utah; reported (Jones, 1923) from northern Colorado.—Map No. 163.—Late April and May, into June at great elevations westward.

ASTRAGALUS GILVIFLORUS (pale yellow-flowered, appropriate only to herbarium specimens) Sheld. in Minn. Bot. Stud. 1: 21. 1894, a substitute for *A. triphyllus* (three-leaved) Pursh, Fl. Amer. Sept. 2: 740. 1814 (non Pall., 1800).—"In Upper Louisiana, Bradbury."—Holotypus, labeled "Louisiana, Bradbury. Pursh's specimens," PH (herb. Pursh.)! isotypi, BM, NY (frag. ex herb. Lambert.)!—*Phaca triphylla* (Pursh) Eat. & Wright, N. Amer. Bot. 351. 1840. *Tragacantha triphylla* (Pursh) O. Kze., Rev. Gen. 948. 1891. *Orophaca triphylla* (Pursh) Britt. in Britt. & Br., Ill. Fl. 2: 306, fig. 2154. 1897.

Phaca caespitosa (tufted) Nutt., Gen. 2: 98. 1818.—"... near the confluence of Sawanee River and the Missouri."—No spm. so labeled found at BM, K, NY, or PH; lectotypus, labeled by Nuttall "*Phaca *caespitosa*. Missouri." GH!—This name, based at least in part on *A. triphyllus* Pursh, should perhaps be considered an illegitimate substitute for the preceding.—Non *A. caespitosus* Pall., 1800, nec Gray, 1864.



Map No. 163. Montana, Wyoming, the Dakotas, and parts of adjoining states and provinces. Range of ▼ *A. gilviflorus*; of ▲ *A. proimanthus*; and of ♦ *A. hyalinus*.

Phaca argophylla (silver-leaved) Nutt. ex T. & G., Fl. N. Amer. 1: 342. 1838.—“Summits of mountains on the upper waters of the Platte.”—Holotypus, labeled by Nuttall “*Phaca *argophylla*. R. Mts. Platte.” BM! isotypus, K!—Non *A. argophyllus* Nutt. ex T. & G., 1838.—*Orophaca argophylla* (Nutt.) Rydb. ap. Britt., Man., Ed. 2. 1067. 1905, quoad nom. sol.

The plains orophaca, *A. gilviflorus*, the first and best-known species of its type, is rather variable in the shape of the leaflets and especially in the size of the flowers, but the taxonomist attempting to correlate the variable features and to explore through them the possibilities of racial differentiation is at a disadvantage because of the scarcity of flowering material in herbaria. The species is among the earliest spring flowers of its region, bursting into bloom with the first warm weather from buds formed apparently in winter. The blooming period is short and usually long past before professional collectors take to the field. So far as known the commonest, presumably typical phase of *A. gilviflorus* has narrowly oblanceolate leaflets (at least in mature leaves) and long, whitish flowers with calyx mostly 13–20 mm., a dorsally glabrous banner 20–28 mm., and a keel 15–22 mm. long. In western Montana (Custer, Lewis and Clark, Meagher, and Glacier Counties, probably elsewhere) plants with comparatively short flowers (calyx $\pm$ 9–10 mm., banner 16–18 mm., keel 10.5–12 mm. long) seem to be common, but I do not know whether these replace the ordinary sort. In some small-flowered plants the leaflets are comparatively short and broad in all leaves, but this is known to occur occasionally in combination with a long flower (= *Phaca argophylla*). The leaves of the plains orophaca are so often dimorphic, with longer petioles and leaflets in leaves produced after anthesis, that it is fair to regard this peculiarity as characteristic of the species. Other variants noticed in Montana by the observant collector C. Leo Hitchcock (the characters not always verified by me) are one with “corolla blue, the banner hairy on the back” (from Wheatland County, No. 16,308) and another with “keel ciliate on the upper half” (from Broadwater County, No. 15,886). On the upper Wind River in Wyoming, at elevations above normal for the species, some populations of *A. gilviflorus* are characterized by long, glabrous flowers varying from pale bluish-lilac to vivid pink-purple. All of these variants require and deserve attentive study.

The flowers on a plant of *A. gilviflorus* ordinarily bloom in rapid succession and last only for a few days, making a bright but fugitive display. As a rule only the neat lower leaves have reached full size at this time, and the long, narrow, glistening white flowers, which stand erect out of the crowns of silvery foliage, are wonderfully handsome. The plains orophaca can be grown with some difficulty in the eastern United States but is not long-lived under garden conditions, and moreover, its brief blossoming period does not recommend it. In summer, when the mature leaves have developed and the flowers have withered to papery tatters in the leaf-axils, even healthy plants take on an untidy, moribund appearance which is far from ornamental.

367. ASTRAGALUS PROIMANTHUS

Densely cespitose or pulvinate, the branches of the repeatedly forking caudex becoming columnar from a thatch of marcescent stipules and leaf-stalks, the whole forming tufts or low-convex cushions up to 2 (3) dm. in diameter, the herbage silvery-hirsute with ascending, $\pm$ twisted or sinuous hairs up to 1.5–2.8 (3) mm. long, the leaflets equally pubescent on both sides; *stipules* hyaline, lanceolate or ovate, 7–12 mm. long, united behind the petiole through $\frac{3}{4}$ or more of their length, fully amplexicaul and in early veneration shortly connate (but the union early ruptured by the expanding shoot), glabrous or nearly so dorsally, thinly hirsute-ciliate; *leaves* 1.5–3.5 cm. long, the petiole a little widened and flattened at base, the 3 (rarely 1) leaflets narrowly obovate to oblanceolate or elliptic-oblanceolate, acute or subacute, (3) 5–9 mm. long; *peduncles* subobsolete, the flowers sessile or nearly so in axillary pairs; *bracts* hyaline, lanceolate, ovate- or lance-acuminate, or -caudate, sometimes tridentate with short lateral teeth, 3–6 mm. long; *pedicels* subobsolete; *bracteoles* similar to the bracts but shorter and narrower; *calyx* 8.3–10.5 mm. long, densely white-hirsute, the turbinate disc 1–1.2 mm. deep, the cylindric or deeply cylindro-campanulate tube 5.9–6.5 mm. long, 3.1–3.5 mm. in diameter, membranous becoming scarious, fragile, ultimately ruptured dorsally by the expanding ovary, the firm, narrowly subulate or almost linear teeth 2.4–4.2 mm. long; *petals* apparently whitish, pale yellow when faded, all glabrous; *banner* erect or almost so, narrowly fiddle-shaped, the oblong-oblanceolate claw and blade of about the same length and width, the whole 12.3–17 mm. long, 4.8–5.2 mm. wide,

openly notched at apex; *wings* 11.1–16 mm. long, the claws 4.6–8.5 mm., the narrowly oblong-oblancoelate, obtuse, straight blades 4–8 mm. long, 2.2–2.6 mm. wide; *keel* 11.1–12.8 mm. long, the claws 7.1–8.2 mm., the subsymmetrically elliptic blades 4.3–4.8 mm. long, 2.2–2.5 mm. wide, incurved through $\pm 45^\circ$ to the broadly triangular apex; *anthers* 0.55–0.8 mm. long; *pod* erect, sessile, narrowly ellipsoid, 7–10 mm. long, 2.5–3 mm. in diameter, straight or a trifle decurved, somewhat laterally compressed but the sutures not prominent, the sides low-convex, the somewhat fleshy, green, and densely hirsutulous valves becoming leathery, not inflexed; *dehiscence* downward through both sutures, the valves coiling; *seeds* not seen.—Collections: 2 (ii), cited below.

Summits of barren, white shale hills and on ridges of gullied shale bluffs, 6500–7100 feet, forming colonies but apparently local, known only from the valley of Henry's Fork of the Green River near McKinnon, southern Sweetwater County, Wyoming.—Map No. 163.—May (flower), the fruit ripe in late June or early July.

ASTRAGALUS PROIMANTHUS (precociously flowering), sp. nov., inter *A. hyalinum* Jones et *A. gilviflorum* Sheld. quasi intermedia, illum vexillo brevi platyonychio 12.5–17 mm. tantum longo simulans sed petalis glabris, ovulis 11–14 (nec 8–9) et anthesi vernali (mense Maio in desertis elatis 7000 ped. versus) absimilis, ab hoc floribus minusculis, vexilli forma et legumine anguste ellipsoideo ± 7 –10 mm. longo, 2.5–3 mm. diametro ulterius distans.—Densissime caespitosa vel subpulvinata, laxa densissime cano-hirsuta; *folia* 1.5–3.5 cm., foliola 3 oblanceolata vel anguste obovata 3–9 mm. longa; *flores* bini in stipularum hyalinarum axillis sessiles; *calycis* 8.3–10.5 mm. longi tubus subcylindricus membranaceus ± 6 –6.5 mm. longus dentes firmi 2.4–4.2 mm. longi; *petala* sicca flava immaculata, omnia glaberrima, caeterius illis *A. hyalini* simillima, vexillo platyonychio 12.3–17 mm., carina 11–12.8 mm. longis; *legumen* anguste ellipsoideum, de latere subcompressum, stylo decurvo apiculatum, 1-loculare, valvulis subcarnosis demum coriaceis per suturas ambas dehiscentibus extrorsus tortis; *ovula* 11–14.—WYOMING: 3 miles north of McKinnon, Sweetwater County, 7100 feet, June 13, 1961, *Barneby 13,185*.—Holotypus, CAS! isotypi, GH, NY, RM, RSA, US!—First collected June 13, 1946, 6 miles n. of McKinnon, *Ripley & Barneby 7913* (RSA).

The precocious orophaca, *A. proimanthus*, combines some striking characters of each of its close relatives, *A. hyalinus* and *A. gilviflorus*. It resembles *A. hyalinus* in its dwarf habit of growth and in the short flower with its fiddle-shaped, platyonychious banner, but the petals are glabrous and the blooming period is earlier by a month or nearly so. The ovule number lies within the range of variation known in *A. gilviflorus*, but the narrowly ellipsoid fruit and shorter, differently shaped banner are quite distinct. The plants form comparatively small tufts as in *A. gilviflorus*, not the very large, high-convex cushions characteristic of *A. hyalinus*. The relatively loose and spreading pubescence of the leaves lacks the silvery sheen which is one of the most attractive features of the other orophacas. Until well-developed fruit of *A. hyalinus* is collected, no valid comparison of the pods can be made; however, the tumescent ovary of *A. hyalinus* is shorter and plumper than that of *A. proimanthus* at the same stage of growth and contains only 4–5, not 6–7 pairs of ovules. A genuine difference in the ripe pod can be anticipated.

Both collections of *A. proimanthus* were made on June 13, when the plants were well past anthesis, even though at this date it is still early spring at 7000 feet in the north foothills of the Uintahs. The faded flowers, many of which (in both stations) were eaten away by birds or insects, are of a pale yellow color, papery and fragile. They may have been either white or ochroleucous when fresh.

368. *ASTRAGALUS HYALINUS*

Densely caespitose when young, becoming pulvinate, with a closely and repeatedly forking, suffruticulose caudex beset with a columnar thatch of persistent petioles and stipules, at length forming low, hard cushions or domed mounds 1–4 dm. in diameter, the herbage villous-strigose nearly throughout with narrowly and loosely ascending, straight or partly wavy hairs up to 1–2 mm. long, silvery-silky; *stems* of the year mostly reduced to crowns of loosely rosulate leaves and closely imbricated stipules, rarely a little developed and up to 2 cm. long, but the inter-

nodes always concealed; *stipules* hyaline, ovate or obovate, mostly 6–10 mm. long, adnate behind the petiole and (at least in veneration) connate opposite it into a loose, transversely wrinkled sheath, glabrescent dorsally, thinly long-ciliate; *leaves* 0.7–3 cm. long, with rather stiff, at length recurving petiole and 3 oblanceolate or (when short) obovate, subacute or obtuse, loosely folded leaflets 2.5–10 mm. long; *peduncles* very short or obsolete, concealed by the stipules, not over 4 mm. long; *racemes* subcapitately 1–2 (3)-flowered, the flowers erect, the axis not elongating; *bracts* hyaline, ovate or broadly lance-acuminate, boat-shaped, 3–5 mm. long; *pedicels* very short or subobsolete; *calyx* 7.3–10.7 mm. long, densely silvery-villous, the turbinate disc 1.3–2 mm. deep, the narrowly cylindric tube 5.8–7 mm. long, 2.1–3 mm. in diameter, the subulate or linear-subulate teeth 1.5–3.7 mm. long, the whole becoming scarious, fragile, distended and apparently ruptured by the swelling pod; *petals* whitish, the keel- and wing-tips faintly lilac-tinged; *banner* nearly erect, 12.5–17.6 mm. long, the oblanceolate or cuneate-oblanceolate claw 6.2–8.3 mm., the linear or linear-oblong, obtuse or emarginate, straight blades 5.6–9.2 mm. long, 1–2 mm. wide; *keel* 10–13 mm. long, the claws 6.5–9 mm., the ovate-elliptic, scarcely oblique blades 4–4.6 mm. long, 1.6–2.2 mm. wide, gently incurved through 45° to the obtuse apex; *anthers* 0.55–0.7 mm. long; *pod* apparently as in *A. gilviflorus*, densely pubescent when young, not seen fully formed; *dehiscence* and *seeds* unknown.—Collections: 15 (viii); representative: *Osterhout* 4008 (NY, RM, WIS); *Ripley & Barneby* 8937, 8951, 10,556 (CAS, RSA); *E. Nelson* 705 (RM), 4949 (NY, RM); *Goodding* 176 (RM, US); *Barneby* 13,224 (NY, RSA).

Barren hilltops, gullied bluffs, and badlands, on sedimentary formations, mostly shales and limestones, sometimes on red beds, 3500–7500 feet, locally plentiful in scattered stations along the North Platte River and its tributaries in southeastern Wyoming and western Nebraska, north to the west foothills of the Black Hills, South Dakota, and in Wyoming to the Powder River and west slope of the Big Horn Mountains, south to the Arikaree River in northeastern Colorado; reported (C. L. Porter, 1951, p. 6) from North Dakota.—Map No. 163.—Flowering from late June to early August.

ASTRAGALUS HYALINUS (glassy-transparent, of the stipules) Jones in Proc. Calif. Acad. Sci. II, 5: 648. 1895.—"Upper Lawrence Fork, Kimball County, Nebraska, No. 80; Cliffs, Banner County, Nebraska, August 1890; Hills, Kiowa Valley, Scott's Bluff County, Nebraska. All collected by Rydberg. Type in University of Nebraska and duplicate types in National Herbarium."—Holotypus, not examined; isotypi, *Rydberg* 80 (from Scott's Bluff County), US! *Rydberg in August, 1890* (from Banner County), US!

Phaca caespitosa β Hook. in Lond. Jour. Bot. 6: 212. 1847.—"Stony plains, on the north and south Forks of the Platte... Geyer n. 166."—Holotypus, K! isotypi (some dated "1845," but probably collected in 1843), BM, G, OXF!

Orophaca argophylla sensu Rydb. in N. Amer. Fl. 24: 310. 1929; non *Phaca argophylla* Nutt.

The three striking features of the summer orophaca, *A. hyalinus*, are the platyonychiaous banner, the pubescent petals, and the late season of bloom. The banner, like that of the related but early spring-flowering *A. proimanthus*, takes the form of two oblanceolate leaves of about equal length and width superimposed one above the other, making a fiddle-shaped figure quite distinct from the simply oblanceolate banner of *A. gilviflorus*. The flower of *A. hyalinus* is ordinarily much smaller than that of *A. gilviflorus*, the petals of which are with rare exceptions quite glabrous, and at best only puberulent on the back of the banner. Jones (1923, p. 86) suggested that *A. hyalinus* might be no more than an abnormal form of *A. gilviflorus*, but this is certainly not so. Though the two species inhabit almost identical environments and are partly sympatric, they are sharply differentiated morphologically and isolated genetically by the gap between their seasons of bloom. The period of anthesis is governed to some degree by altitude and exposure as well as by seasonal variation, but at the same latitude and elevation flowering of the two species is separated by an interval of three to four weeks. In western

Nebraska *A. gilviflorus* is in flower from the last week in April through May, but rarely persists into the last week of the latter month; whereas *A. hyalinus* has been collected in flower in the same area only between the middle of June and the third week of July. In mid-June, 1961, *A. gilviflorus* was in ripe fruit on the Powder River in northeastern Wyoming at a time when the buds of *A. hyalinus* were only just beginning to emerge from the stipular sheaths. As seen in the field, *A. hyalinus* is often recognizable even when sterile by its habit of forming extremely large, domed cushions of neat and short, silvery foliage; the average plant of *A. gilviflorus* is at once coarser in detail and forms smaller tufts.

It is remarkable that although *A. hyalinus* was first discovered almost 120 years ago, the ripe fruit of the species is still unknown.

APPENDIX I. DOUBTFUL AND IMPERFECTLY KNOWN SPECIES

1. *ASTRAGALUS BIDENTATUS* Kunth in H. B. K., Nov. Gen. & Sp. (folio) 6: 385, Tab 584. 1823.
—No locality recorded.

Jones (1923, p. 189) listed *A. bidentatus* as a probable synonym of *A. guatemalensis*, although (as Rydberg, 1929, p. 454, has already remarked) there is no reason to suppose that the plant was North American in origin or that the beautifully executed figure is a misrepresentation of *A. guatemalensis*. The holotypus (P, herb. H. B. K!) is persuasively suggestive of *A. Weberbaueri* Ulbr., a subshrubby astragalus of the Ecuadorean and Peruvian Andes which has been collected near Quito (cf. Johnston, 1935, p. 89, 90), and therefore might have been encountered by Humboldt's party. I find only one discrepancy, which a more careful study of the holotypus might dispel: the ovules of *A. Weberbaueri* are 3, 4, or 5, whereas Kunth described and figured the ovary of *A. bidentatus* as 8-ovulate.

2. *ASTRAGALUS DALEAE* Greene, Pittonia 1: 153. 1888.—". . . part of a collection made by Mr. A. Forrer, in the autumn of 1881, on the higher Sierra Madre back of the city of Durango, in Mexico . . ."—Holotypus, labeled "Sierra Madre, west of Durango, Mexico, alt. 8100 feet, September and October, 1881, *A. Forrer.*," ND! isotypus, GH!

I have associated with the typus of *A. Daleae* two other collections from the region (33 and 30 miles southwest of El Salto, Durango, *Waterfall 12,715*, CAS, RSA, *16,211*, NY); like the original gathering they have either only flowers or a few forming pods not yet sufficiently far advanced to show the ultimate structure or texture. The species is evidently a distinct entity, possibly a close ally of *A. Hartwegi* which it suggests, except for some peculiar characters, especially the ochroleucous (not purplish), regularly even though only slightly graduated petals, broad leaflets, and especially the broad, boat-shaped, *Dalea*-like bracts which must have suggested the specific name. The very young pod seems to be decurved, rather than incurved as in *A. Hartwegi*, and may prove quite different when known in the ripe stage. The following description may be helpful in recognizing the species:

Slender, diffuse, with a superficial or shallowly buried root-crown, thinly strigulose with appressed hairs up to 0.3–0.5 mm. long, the herbage green, the leaflets glabrous above; *stems* 1.5–4.5 dm. long; *stipules* 2–10 mm. long, the lower ones small, papery, the upper ovate to lance-acuminate, herbaceous, all free; *leaves* 3–7.5 cm. long, with (15) 17–31 oblong-obovate or -elliptic leaflets 2–10 mm. long; *peduncles* 4–10 cm. long; *racemes* at anthesis densely and narrowly (20) 25–65-flowered, the flowers at length recurved and loosely retrorse-imbricated, the axis at least 3–8 cm. long in fruit; *bracts* green or purplish, becoming pallid at base, broadly elliptic, acute or subacute, cymbiform, at first erect, imbricated, and concealing the buds, at length spreading or deflexed, 2–7 mm. long, 0.8–3 mm. wide, glabrous or thinly strigulose dorsally; *calyx* 2.7–3.6 mm., the tube 1.9–2.5 mm. long, about as broad, the triangular-subulate teeth 0.8–1.1 mm. long, the ventral pair shortest and broadest; *petals* greenish-white or ochroleucous; *banner* recurved through 85–95°, ovate- or suborbicular-cuneate, 5.6–6.5 mm. long, 4.4–5 mm. wide; *wings* a trifle shorter, the blades lunately elliptic, gently (and equally) in-

curved; *keel* 4.7–5.4 mm. long, the blades 2.6–2.9 mm. long, abruptly incurved through 80–95° to the blunt apex; *ovary* and forming pod sessile, the latter loosely reflexed, linear, gently arched downward, apparently triquetrous, thinly black- and white-strigulose, semibilocular; *ovules* 9–11.

3. *ASTRAGALUS DORYCNIODES* Dougl. ex G. Don, Gen. Hist. Dichl. Pl. 2: 258. 1832.—“Native of North America, near the Columbia River.”—Holotypus not located, presumably lost with dispersal of the Lambert Herbarium.

Don described *A. dorycnioides* as an elegant plant a foot in height, purple-flowered, and densely clothed in hoary, silky villi. The stems were supposedly erect, the leaflets obovate-linear and obtuse, the calyx smooth, and the racemes longer than the leaves. The name has been associated with *A. succumbens* (Jones, 1929, Index; Rydberg, 1927, p. 14, & 1929, p. 419), but this also was known to Don (op. cit., p. 263) and characterized in some detail, its hirsute vestiture being called “very villous,” but not silky. None of several Douglas specimens of *A. succumbens* at BM, K, or OXF bears the epithet *dorycnioides*, and it seems somewhat unlikely that Douglas could have written two different names for so strikingly individual a species. It is perhaps not wholly irrelevant that *A. succumbens* bears only a very remote likeness to most species of *Dorycnium*. Unless an authentic typus of *A. dorycnioides* exists, the name cannot be interpreted with success.

4. *ASTRAGALUS FIGUEROAI* Kamffer & Ancona in “Rev. Inst. Pecuario (Mexico) 1, no. 2: 13, fig. 2, 3. 1942.”

This species is known to me only from the cited reference in the Gray Card Index. I have not found the publication in any library to which I have had access. The species is said to inhabit the states of Mexico and Hidalgo.

5. *ASTRAGALUS HARTMANII* Rydb. in N. Amer. Fl. 24: 442. 1929.—“Type collected near San Diego Ranch, Chihuahua, *Hartman 678* . . .”—Holotypus, collected at 6000 ft., May 2, 1891, on Dr. Carl Lumholtz’s Archeological Expedition to Northwestern Mexico, NY! isotypi, GH (2 sheets), K!

This extremely distinct species, remarkable for the great length of the narrow, whitish flowers, suggests either the *Sarcocarpi* or the *Mollissimi* in habit of growth, and resembles the latter section in its tawny pubescence. The fruit is unknown, and so I am obliged to list *A. Hartmanii* as an imperfectly known species. It was compared by Rydberg with *A. giganteus*, from which the extremely ample glabrescent foliage and much longer flower easily distinguish it, but the narrowly oblanceolate, little-recurved banner is more suggestive of *A. (Sarcocarpi) sanguineus*. It should be recognized with ease by the following description:

Coarse perennial, thinly pilose with long, straight, narrowly ascending hairs up to $\pm$ 1–1.5 mm. long, the stems $\pm$ hirsutulous with shorter, curly hairs, the vestiture turning rusty when dry, the herbage green, the leaflets glabrous or nearly so above; *stems* at least 1–2 dm. long; *stipules* broadly lanceolate to deltoid-acuminate, 7–20 mm. long, free; *leaves* (7) 14–25 cm. long, with $\pm$ 21–25 broadly rhombic-elliptic to broadly oblanceolate, obtuse or acute, thin-textured, pinninerved leaflets (10) 15–55 mm. long; *peduncles* 12–23 cm. long, stout, striate; *racemes* $\pm$ 15–25-flowered, the flowers widely ascending at anthesis, the axis at least 10 cm. long in fruit; *bracts* membranous, pallid, linear-lanceolate, 5–10 mm. long; *calyx* 28–29 mm. long, pallid, thinly pilosulous, the disc 4–4.5 mm. deep, the broadly cylindric tube 16.5–17 mm. long, 6–7 mm. in diameter (constricted upward), the teeth $\pm$ 11–12 mm. long; *petals* apparently whitish; *banner* recurved through 20°, oblanceolate, emarginate or subentire, 36–37 mm. long, 11 mm. wide; *wings* 34 mm., the blades 15 mm. long, 3.3 mm. wide; *keel* 32.5 mm., the claws 21 mm., the half-obovate blades 13 mm. long, 4.3 mm. wide, incurved through 50° to the sharply deltoid apex; *ovary* sessile, glabrous; *ovules* 42–46.

6. *ASTRAGALUS LEPTOPHYLLUS* Nutt. in Jour. Acad. Sci. Philad. 7: 18. 1834.—“*Hab.* The head waters of the Missouri.”—Holotypus, labeled by Nuttall “*Astragalus *leptophyllus*. Heads of the Missouri.” collected in 1833 by Nathaniel B. Wyeth, PH! isotypi, BM, NY!—*Astragalus stenophyllus* T. & G., Fl. N. Amer. 1: 329. 1838, a legitimate substitute (non *A.*

leptophyllus Desf., 1800). *Tragacantha stenophylla* (T. & G.) O. Kze., Rev. Gen. 948. 1891. *Homalobus stenophyllus* (T. & G.) Rydb. in Mem. N. Y. Bot. Gard. 1 (Fl. Mont.): 249. 1900. *Phaca stenophylla* (T. & G.) Piper in Contrib. U. S. Nat. Herb. 11 (Fl. Wash.): 371. 1906.

Due to the immaturity and incompleteness of the type-specimens, *A. leptophyllus* Nutt. is open to two interpretations, either as likely correct from the point of view of the geographic origin so far as this can be determined. The substitute *A. stenophyllus* is the earliest name either for *A. (Cusickiani) filipes* or for *A. (Reventi-arrecti) atropubescens*; but as it can be assigned certainly to neither, it has become a nomen ambiguum. The identity of the species and the application of the name *A. stenophyllus* are discussed in detail under *A. filipes*, q.v.

7. *ASTRAGALUS TOMENTOSUS* Sessé & Moc., Pl. Nov. Hisp. 119. 1889.—“Habitat in aridis Michaeopolitanis agris [i.e., San Miguel Allende, Guanajuato].”—No typus known to exist.—Non *A. tomentosus* Lamk., 1783.

The description of *A. tomentosus* Sessé & Moc. calls for a tomentose annual plant about 3 dm. tall, with tiny leaflets and very small, pale yellow, spicate flowers giving rise to pendulous, subulate pods about twice the length of the calyx. No truly annual Mexican *Astragalus* conforms with this description; but if the duration of the root is disregarded, the remaining characters suggest *A. hypoleucus* or *A. Goldmani*. The application of the name is unimportant, as it is a later homonym.

8. *PHACA DEBILIS* Nutt. ex T. & G., Fl. N. Amer. 1: 345. 1838.—“Plains of the Rocky Mountains, near streams . . . Nuttall.”—Typification ambiguous; cf. discussion following.—*Astragalus debilis* (Nutt.) Gray in Proc. Philad. Acad. 1863, p. 60. 1864, in nota.

Two specimens labeled by Nuttall “*Phaca *debilis*. R. Mts.” are known to exist, one in Nuttall’s own herbarium (BM), the other at NY (herb. Torrey.). Both are in young flower and obviously represent parts of the same collection. The example at NY was identified by Rydberg as *Diholcos distortus* (= *A. distortus* T. & G.), and it agrees closely with some forms of *A. distortus* var. *Engelmanni*, although it is perhaps rash to name it at all without the fruit. This same specimen was examined by Gray, but in his Revision (1864, p. 233) he listed *P. debilis* as an obscure species. Jones (1923, p. 88) took up the name and applied it to our *A. Bodini*, a plant of streamside habitats in the Rocky Mountains, although the material now associated with Nuttall’s labels cannot represent that species. Curiously enough Nuttall did collect a small flowering specimen of *A. Bodini*, now in his herbarium (BM). It is mounted with a characteristic Nuttall label reading “*Astragalus *miser*. R. Mts.,” a name which was not published in Torrey & Gray’s Flora (and has nothing in common with *A. miser* Dougl.). One may conjecture that Nuttall collected this plant on the Sweetwater River in Wyoming, where several of the early botanists following the Overland Trail via South Pass also encountered it in the middle XIX century. The habitat given for *P. debilis* naturally suggests *A. Bodini*, but the specimens now labeled *debilis* and the description of the species cannot belong there. There seem to be two possible interpretations of Nuttall’s plants. Either *Phaca debilis* really does exist, a Cordilleran mesophyte represented by the Nuttall specimens so labeled, but known only from this one flowering collection which only simulates, but is not the real *A. distortus* var. *Engelmanni*; or the data properly belonging to Nuttall’s *A. miser* (our *A. Bodini*) was somehow transferred to specimens of *A. distortus* and the description of *P. debilis* derived from these. The problem seems insoluble.

APPENDIX II. INTRODUCED SPECIES

1. *ASTRAGALUS CHINENSIS*

Coarse perennial, with subterranean root-crown, thinly strigulose with basifixed hairs up to 0.3–0.6 mm. long, the prominently ribbed, stramineous stems glabrous, the leaflets glabrous above; stems erect, often solitary, 3–6 dm. long; stipules free; leaves 7–15 cm. long, short-petioled, with 17–27 oblong-elliptic, obtuse but apiculate, flat leaflets 14–30 mm. long; peduncles erect, 2–6 cm. long; racemes loosely 7–15-flowered, the flowers nodding in age, the axis $\pm$ 3–5 cm. long

in fruit; *pedicels* persistent; *bracteoles* 2; *calyx* 5–7 mm. long, subglabrous, the tube campanulate, the broadly subulate teeth 1.5–2.5 mm. long, the whole marcescent unruptured; *petals* pale yellow, irregularly graduated, the banner 13–15 mm. long, the broad, prominent keel a little shorter, the narrow wings shortest, $\pm$ 11 mm. long; *pod* pendulous, stipitate, the slender stipe 6–8 mm. long, the body plumply oblong-obovoid, somewhat inflated but not bladdery, broadly rounded (or very obscurely beaked) at apex, (9) 11–14 mm. long, (5) 6–10 mm. in diameter, a little obcompressed, with low-convex ventral and dorsal faces (the former carinate by the prominent suture) and broadly rounded lateral angles, the fleshy, green, glabrous valves becoming subligneous, brownish, transversely rugulose-reticulate, inflexed as a broad and complete septum; *dehiscence* apical, basal, and through both sutures; *ovules* $\pm$ 12–14; *seeds* brown, smooth but dull, 2–3 mm. long.

Native to rich meadows, bottomlands, and river banks on the plains of northern China and Manchuria, north to the Ussuri and lower Amur Valleys, locally established in Fremont County (near Dubois), Idaho.—June to August.

ASTRAGALUS CHINENSIS L. fil., Dec. Pl. Rar. Hort. Upsal. 1: 5, Tab. III. 1762.—“HABITAT in China, unde anno 1760 inter varia alia semina advenit.”—Holotypus, cult. in hort. Upsal., 1760, LINN!

The China milk-vetch is an altogether peculiar astragalus, justly made by Gontscharov (1946, p. 876) the typus of a monotypic sect. *Nuculiella*. It had been referred by Bunge (1869, p. 32) to the heterogeneous sect. *Diplothea*, a group without close kindred in America. The species may be recognized by its coarse growth combined with irregularly graduated, yellowish petals (the narrow wings shortest, the keel and banner of nearly equal length), and especially by the pendulous, stipitate pod which, although decidedly inflated, is not at all bladdery, its fleshy, ultimately ligneous walls becoming prominently rugulose-reticulate when ripe.

2. ASTRAGALUS CICER

Diffuse, leafy perennial, strigose-pilosulous with rather stiff, subappressed or narrowly ascending hairs up to 0.4–0.7 mm. long, the flexuous stems thinly so or glabrate, the herbage green, or cinereous when young, the thin-textured, veiny leaflets pubescent on both sides or glabrate above; *stems* prostrate or weakly ascending, (2) 3–7 dm. long, commonly branched or spurred at 1–several nodes preceding the first peduncle; *stipules* 2–8 mm. long, dimorphic, the lowest short, connate into a bidentate sheath, the upper ones longer, connate only at base or free, with lanceolate or lance-acuminate or -caudate, usually sharply deflexed blades; *leaves* 4–21 cm. long, all or all but the lowest ones subsessile, with (13) 17–19 (31) lance-elliptic, oblong, subacute or obtuse and mucronulate, flat leaflets 0.5–3.5 cm. long; *peduncles* 4–11 cm. long, usually much shorter than the leaf; *racemes* rather densely (6) 10–30-flowered, the flowers ascending, the axis not or little elongating, (1.5) 2.5–5 cm. long in fruit, the pods crowded into oblong or subcapitate heads; *bracts* narrowly lanceolate or linear, thinly pilose-ciliate, 2–6.5 mm. long; *pedicels* ascending or spreading in age, at anthesis 0.3–0.8 mm., in fruit thickened, 0.5–1.5 mm. long; *bracteoles* 0; *calyx* 6.6–9 mm. long, strigulose with black or fuscous, rarely with whitish hairs, the shallow, subsymmetric disc 0.5–0.8 mm. deep, the deeply campanulate or ovoid-campanulate tube 5–6 mm. long, 3.2–4 mm. in diameter, the triangular-acuminate teeth 1.6–3 mm. long, the whole becoming papery-membranous, somewhat distended but finally ruptured, marcescent; *petals* ochroleucous; *banner* nearly erect, oblanceolate or spatulate, 12.5–16.2 mm. long, 4.5–6.6 mm. wide; *wings* 11–14.5 mm. long, the claws 5.5–6 mm., the narrowly oblong or elliptic, obtuse or obliquely emarginate, straight blades 5.8–9.8 mm. long, 1.3–2.2 mm. wide; *keel* 9.6–10.5 mm. long, the claws 5.5–6 mm., the half- or obliquely obovate blades 4.7–5.2 mm. long, 2–2.4 mm. wide, incurved through $\pm$ 90° to the bluntly deltoid apex; *anthers* 0.45–0.65 mm. long; *pod* ascending or

(when crowded) spreading, subsessile, the stipe up to 0.8 mm. long, usually less, the body broadly ovoid or subglobose, inflated but hardly bladdery, 6–14 mm. long, 5–8 (10) mm. in diameter, broadly rounded, truncate, or umbilicate at base, contracted distally into a short, subulate, declined beak, shallowly sulcate ventrally, the somewhat fleshy, green, white- or partly to wholly black- or fuscous-pilose or -pilosulous valves becoming leathery or stiffly papery, brown or ultimately black, inflexed as a complete septum; *dehiscence* apical.—Collections: 34 (o); American: *Carl Johansen* (from north of Bellingham, Whatcom County, Washington) in 1946 (WS).

Widely dispersed in moist grassy places, along streams and ditches, in hedges, and in open woodland over most of continental Europe, from southern Sweden to northern Spain, east to Finland, European Russia, the Caucasus, and Armenia, introduced in the United States for trial as a cover or forage crop, reportedly naturalized in Whatcom County, Washington, in southern Manitoba (near Brandon), and possibly also in northeastern Nevada (Elko County, *Train* 895, NA).—Summer.

ASTRAGALUS CICER (generic name of the chick-pea, the plant known to some pre-Linnaean botanists as *Cicer sylvestre*) L., Sp. Pl. 757. 1753.—“*Habitat* in Austria, Helvetia, Italia.”—Typus not examined.—*Cystium Cicer* (L.) Stev. in Bull. Soc. Nat. Mosc. 29: 147. 1856.

The chick-pea milk-vetch, *A. Cicer*, may be recognized in America by a combination of easily observed morphological features. The stipules at base of the long, diffuse stems are connate-sheathing; the foliage is ample and of thin texture; the flowers ascend at a narrow angle and are crowded into an ovoid or oblong, spikelike head on peduncles nearly always shorter than the leaf; the petals are ochroleucous, little incurved, the banner bent through no more than 20° and often less; and the pod is subsessile, inflated but stiff-walled, and fully bilocular. The broad membranous leaflets are characteristic of a mesophytic astragalus.

The nearest relative in America of *A. Cicer* is the native *A. agrestis*. Both belong to sect. *Hypoglottoidei*, but have been referred by Gontscharov (1946, pp. 249, 257) to different series in the section. Their distinguishing characters have been set out in key form under sect. *Hypoglottoidei* (q.v.).

3. *ASTRAGALUS CONTORTUPLICATUS*

A coarse annual (possibly sometimes biennial), hirsute throughout with spreading, basifixed hairs up to $\pm$ 1–1.5 mm. long; *stems* diffusely radiating from the superficial root-crown, up to 4 (4.5) dm. long, floriferous from near the base; *stipules* free; *leaves* 5–15 cm. long, with 13–21 oblong-obovate or -ovate, retuse leaflets 4–17 mm. long; *peduncles* 1.5–4 cm. long; *racemes* subcapitately 5–15-flowered, the axis scarcely elongating; *calyx* $\pm$ 5 mm. long, the slender teeth longer than the campanulate tube; *petals* whitish, irregularly graduated, the banner 5–6.5 mm. long, the blunt keel nearly as long and considerably surpassing the narrow wings; *pods* spreading in an oblong or globose head, sessile, deciduous, narrowly oblong, $\pm$ 2–3 mm. in diameter, coiled through $\frac{3}{4}$ –1 $\frac{1}{4}$ circles into a ring $\pm$ 6–8 mm. in diameter, the body trigonous, grooved dorsally, the valves papery, thinly hirsute, inflexed as a complete septum.

Native from eastcentral Europe (Hungary) to Beluchistan, northwestern Pakistan, and central Asia, introduced during late XIX century in ballast and wool-waste near the Massachusetts coast, not collected recently and apparently only a waif in our climate; reported, probably by error, from Mexico (Sessé & Moc., Pl. Nov. Hisp. 119. 1889).—Spring and early summer.

ASTRAGALUS CONTORTUPLICATUS L., Sp. Pl. 758. 1753.—“*Habitat* in Sibiria.”—Typus not examined.—*Contortuplicata astragaloides* Medic. in Vorl. Churpf. Phys. Ges. 2: 378. 1787. *Contortuplicata contortuplicata* (L.) Rydb. in N. Amer. Fl. 24: 416. 1929.

An unmistakable astragalus, strongly characterized by its hirsute pubescence, small heads of whitish flowers borne on peduncles shorter than the leaves, irregularly graduated petals, and

especially by the narrow, trigonous, papery pod coiled into a ring considerably less than 1 cm. across. The species is taxonomically isolated and forms the monotypic sect. *Cycloglottis* Bge. (1868, p. 17). It is the typus and only species of the genus *Contortuplicata* Medic., maintained by Rydberg (1929, p. 416; 1930, p. 235).

4. ASTRAGALUS FALCATUS

Stout, leafy, caulescent perennial, with a determinate root-crown, thinly strigulose with dolabriform hairs mostly less than 0.5 mm. long, the herbage green, the leaflets glabrous above; *stems* erect and ascending in clumps, 4–7 dm. tall; *stipules* submembranous, pallid or early becoming so, dimorphic, those at the lowest nodes connate into a (sometimes early ruptured) sheath, the median and upper ones triangular-acuminate or -caudate, semiamplexicaul-decurrent, free; *leaves* (5) 7–22 cm. long, the lowest petioled, the rest sessile, with 19–35 (37) narrowly oblong to lanceolate or elliptic, often acute or subacute leaflets (0.6) 1–3.5 cm. long; *peduncles* stout, 6–17 cm. long; racemes 20–70-flowered, the flowers reflexed at full anthesis, the axis becoming (3) 6–20 cm. long in fruit; *bracts* membranous, small; *pedicels* recurved in fruit, somewhat thickened but disjointing with the fruit; *calyx* 4–5 mm. long, thinly fuscous-strigulose, the disc slightly oblique, the campanulate tube 3–3.5 mm. long, the subulate or triangular-subulate teeth 0.6–1.2 mm. long; *petals* greenish-white, the banner often and the keel-tip sometimes suffused with lurid purple; *banner* recurved through 30–40°, broadly oblanceolate, 9–11 mm. long; *wings* nearly as long or up to 1 mm. shorter, the blade narrowly oblanceolate, obtuse, nearly straight, with a large auricle; *keel* 8–10 mm. long, the half-obovate blades as long or a little longer than the claws, obtuse; *pod* deflexed, sessile but narrowed at base into a thick, stipelike neck no longer than wide, the body narrowly lanceolate or lance-elliptic in profile, lunately incurved through $\pm \frac{1}{5}$ – $\frac{1}{3}$ circle, cuneately contracted at base, more gradually acuminate distally and cuspidate at apex, triquetrously compressed, with narrow but obtuse lateral angles, keeled ventrally by the prominent, thickened suture, grooved dorsally, the thinly fleshy green valves becoming stiffly papery, stramineous, and cross-reticulate, strigulose with pale or dark hairs, inflexed as a complete septum 2–2.5 mm. wide; *dehiscence* apical, tardy; *ovules* 12–14; *seeds* pale brown, smooth but dull, $\pm$ 2–2.5 mm. long.

Native from southeastern Europe east to the Caucasus and Daghestan, introduced and apparently escaping locally in the palouse country of southeastern Washington.—June to August.

ASTRAGALUS FALCATUS Lamk., Encycl. 1: 310. 1783.—“Cette plante croît dans la Russie, & a été envoyée au Jardin du Roi par M. Demidow, de Moscow.”—Typus not examined.

The Russian sickle milk-vetch, *A. falcatus*, has been introduced repeatedly into United States by the Department of Agriculture for trial as a forage crop (cf. Ricker in Leaf. West. Bot. 5: 55), and there has been some question as to whether or not it has become a spontaneous weed in Washington. A collection from Pullman (G. N. Jones 2482, WTU) in July, 1929, which I cited (in Leaf. West. Bot. 4: 279) may have been an escape from the local Plant Introduction Station; but the species had been found near Pullman as early as 1919 (Rena Duthie 506, DS) and has since appeared near Anatone in Asotin County (Nettie M. Cook in 1937, WIS), where it is more likely to be genuinely established. At anthesis *A. falcatus* resembles our *A. canadensis* in its dolabriform vesture and reflexed flowers, but the root is apparently always simple and does not give rise to creeping stolons, the lower stipules alone are connate, and the deflexed, trigonous pods, which fall to the ground together with the disjointing pedicel, are notably different. European botanists refer *A. falcatus* to sect. *Euodmus* Bge., the equivalent of our sect. *Uliginosi*, but it is certainly an aberrant member, considered by Gontscharov as forming a monotypical ser. *Falcati*.

5. ASTRAGALUS GLYCYPHYLLOS

Coarse, leafy perennial, with a shallowly buried root-crown, thinly strigulose with subappressed, basifixed hairs up to (0.3) 0.4–0.75 mm. long, the ample herb-

age green, the leaflets bicolored, pallid beneath, evidently pinnate-veined, the upper surface impressed-reticulate; *stems* diffusely ascending or trailing, simple or few-branched, 4.5–9 dm. long, floriferous from near or below the middle; *stipules* (0.5) 1–2 cm. long, thinly herbaceous or foliaceous, $\pm$ dimorphic, the small lowest ones strongly connate, becoming papery, the large median ones ovate-acuminate or lanceolate, several-nerved, connate (at least in veneration) at base, the upper ones mostly lanceolate, free or almost so; *leaves* (6) 8–20 cm. long, shortly petioled, with 9–13 (15) broadly ovate or oblong, obtuse but apiculate, flat leaflets 1–4.5 (6) cm. long; *peduncles* 1.5–8 cm. long; *racemes* mostly $\pm$ 10–20-flowered, short but rather loose, the flowers at first ascending, declined in age, the axis scarcely elongating, (1) 1.5–3 cm. long in fruit; *bracts* submembranous, narrowly lanceolate or linear-caudate, 2–6 mm. long; *pedicels* at anthesis ascending, $\pm$ 0.5–1.3 mm. long, in fruit much thickened, ascending or arched outward, 1.3–3 mm. long, persistent; *calyx* 5.2–6.5 mm. long, subglabrous or very thinly black- or white-strigulose, the oblique disc $\pm$ 1 mm. deep, the campanulate tube 3.5–4.2 mm. long, 3–3.6 mm. in diameter, the narrowly subulate teeth 1.2–2.9 mm. long, the orifice strongly oblique, the whole becoming papery, marcescent unruptured; *petals* greenish-white, often indistinctly suffused with lurid purple, the claws of wing and keel exserted; *banner* recurved through $\pm$ 40°, broadly oblanceolate, emarginate, 11.5–13.5 mm. long, 6–7.5 mm. wide; *wings* a little shorter, the claws $\pm$ 5–6 mm., the narrowly oblong blade 7–8 mm. long, 1.5–2.2 mm. wide; *keel* 9.5–11 mm. long, the claws 5–5.8 mm., the half-obovate blades 5–5.7 mm. long, 2.5–3 mm. wide, incurved through $\pm$ 90° to the rounded apex; *pod* incurved-ascending, stipitate, the stout, straight stipe 2–3.5 mm. long, the linear-ellipsoid, gently incurved or almost straight body (2.7) 3–3.7 (4) cm. long, 4–5 mm. in diameter, cuneate at base, acuminate distally and cuspidate at apex, obtusely trigonous, carinate ventrally by the suture, sulcate dorsally, the somewhat fleshy, green, minutely strigulose valves becoming leathery, brownish-stramineous, sublustrous, coarsely reticulate, inflexed as a complete septum; *ovules* 19–25.

Widely dispersed in thickets, glades of deciduous woodland, hedgerows, and fallow fields over the greater part of northern and central Europe (but avoiding the Mediterranean Basin), extending east to northern Iran, the Caucasus, and Altai, sparingly naturalized in northeastern United States (northern New York; Indiana), and collected formerly as a waif along the coast of Massachusetts and New Jersey.—May to August, the pods long persisting.

ASTRAGALUS GLYCYPHYLLUS L., Sp. Pl. 758. 1753.—“*Habitat in Europae nemoribus.*”—No typus examined.—*Hedyphylla vulgaris* Stev. in Bull. Soc. Nat. Mosc. 29: 142. 1856. *Hedyphylla glycyphylla* (L.) Rydb. in N. Amer. Fl. 24: 438. 1929 (“*glyciphylla*”).

The liquorice milk-vetch, *A. glycyphyllus*, is sparingly but genuinely naturalized in the eastern United States, where it may be distinguished from the few native species by its coarse procumbent stems, foliaceous stipules, ample leaflets, and shortly pedunculate heads of dingily ochroleucous flowers which give rise to long, narrow, incurved-ascending fruits. According to Deam (No. 57,502) a colony of *A. glycyphyllus* is known to have existed continuously in Fulton County, Indiana, since the middle XIX century, and another, on the Cattaraugus Indian Reservation in New York (near Gowanda), has persisted for over twenty years. The species was collected many years ago in the suburbs of Boston and on ballast at Communipaw Ferry, New Jersey, but it apparently never became established on the coast.

The species has no close kindred in America, but forms with three or four allied Asiatic *Astragali* an isolated sect. *Glycyphyllus* Bge., generally assigned to the heterogeneous and probably polyphyletic subgen. *Phaca*. It is also the typus of the segregate genus *Hedyphylla* Stev. (cf. Rydb., 1930, p. 235, Pl. XVIIIA).

6. SPHAEROPHYSA SALSULA

Caulescent perennial, with widely creeping, woody rhizomes giving rise at

intervals to short, erect, simple or few-branching, subterranean caudices, the stems and herbage strigulose with loosely appressed, mostly scalelike or furfuraceous hairs up to 0.2–0.35 mm. long, the herbage green or greenish-cinereous, the leaflets glabrous above; *stems* arising singly and few together, erect, simple above the immediate base or branched at 1–several nodes near the middle, 4–7 dm. long, stramineous, striate, angular, hollow and pithy within; *stipules* 1–3 (4) mm. long, the lowest mostly deltoid-acuminate, the upper ones narrowly triangular or subulate, all adnate to the leaf-pulvinus, decurrent around $\frac{1}{3}$ or less of the stem; *leaves* (3) 4–10 cm. long, subsessile or shortly petioled, the petiole enlarged at base and jointed to the pulvinus, the leaflets (15) 17–25, oblong-obovate to narrowly oblong or (in some upper leaves) narrowly elliptic, retuse to obtuse and apiculate, or (when narrow) acute, 3–18 mm. long; *peduncles* ascending, (2.5) 3–7 (9) cm. long; *racemes* loosely 5–15 (17)-flowered, the flowers loosely ascending, nodding in age, the axis a little elongating, (1) 2.5–9 cm. long in fruit; *bracts* triangular-ovate or lance-elliptic, 1–2 mm. long; *pedicels* at anthesis slender, ascending, 2.5–5 mm. long, in fruit $\pm$ recurved, thickened, 3–8 mm. long, persistent; *bracteoles* 2; *calyx* 5–6 mm. long, white-strigulose, the teeth often a little more densely so than the tube and very densely so within, the disc 1–1.6 mm. deep, the campanulate tube 3.8–4.6 mm. long, 3.4–4.4 mm. in diameter, the triangular teeth 1.2–2 mm. long, the whole becoming papery, marcescent unruptured; *petals* dull brick- or tomato-red, drying lavender or finally brownish; *banner* recurved through $\pm 45^\circ$, suborbicular-cuneate, openly notched, 12–14 mm. long, 11.5–14 mm. wide; *wings* 10.6–12 mm. long, the claws 2.8–3.4 mm., the oblong, obtuse, slightly incurved blades 9–10 mm. long, 3–3.6 mm. wide; *keel* (0.5–1.5 mm. longer than the wings) 11.3–12.5 mm. long, the claws 4.5–5 mm., the broadly half-obovate blades 7.5–8.5 mm. long, 4.3–5 mm. wide, incurved through $\pm 90^\circ$ to the bluntly deltoid apex; *filaments* dilated downward, those of the sheath unequal (5 longer, 4, like the vexillary one, shorter); *style* glabrous except for a small tuft of hair under the stigma; *pod* ascending, widely spreading, or declined, stipitate, the stout, straight or incurved stipe 4.5–7 mm. long, the plumply ovoid or globose body (1.3) 1.5–2.4 cm. long, (0.9) 1–2 cm. in diameter, bladdery-inflated, broadly rounded or truncate at base, broadly rounded and almost beakless at apex, openly but deeply sulcate ventrally, the stiffly papery, pale green but often purplish-tinted, strigulose (sometimes ultimately glabrate) valves becoming stramineous, reticulate, not inflexed, the funicular flange 0.5–1 mm. wide; *dehiscence* only by weathering, the pod falling unopened to the ground; *ovules* 28–44; *seeds* brown or olivaceous, almost round, smooth but dull, 2–2.4 mm. long.—Collections: Asiatic, 6 (o); American, 21 (ii).

Native to interior Asia, where widely dispersed from the west shore of the Caspian Sea to Mongolia and northern China, introduced along roadside and irrigation ditches, on alkaline flats, and in irrigated pasture (especially with alfalfa), becoming locally plentiful and eventually forming extensive patches, here and there, between 350 and 7900 feet, in the arid western United States: Yakima and Benton Counties, Washington; Umatilla County, Oregon; Snake River Valley in Cassia County, Idaho; Bakersfield Plain, Kern County, California; Carson Sink Region, western Nevada; Wind River Valley, Wyoming; San Luis Valley, southwestern Colorado; northeastern Arizona (near Winslow); and in the Mesilla Valley, southern New Mexico and extreme western Texas.—June to September.

SPHAEROPHYSA SALSULA (Pall.) DC., Mém. Leg. 288. 1825, & Prod. 2: 271. 1825, based on *Phaca salsula* (salty) Pall., Reise 3, Anhang 65, Tab. Bb. 1776.—“Abundat in campis salsis circa Lacum siccum Tarei Dauriae . . .”—Holotypus, BM (herb. Pall.)!—*Swainsona salsula* (Pall.) Taub. in Engl. & Prantl, Nat. Pflanzenfam. III, 3: 281. 1894.

Astragalus violaceus St. John (1929). *A. iochrous* Barneby (1944). For full citation cf. Appendix IV.

This handsome, yet unwelcome immigrant to arid western United States resembles several native astragali in its stipitate, bladdery legume of papery texture and is often mistaken for an unidentified or undescribed milk-vetch. It was first described as a *Phaca* and is introduced into this account of *Astragalus* in order to forestall repetitions of the mistake. The *Sphaerophysa* can be recognized by its brick-red flowers which turn brownish-lavender in age, by the joint between the leaf-stalk and its supporting pulvinus, by the absence of boss and socket on the keel and wings, which lock together the lateral pairs of petals in true *Astragalus*; and finally it differs from American *Astragali* at all like it in habit or in fruit by its apically hirsutulous style. The arrival, or at least the detection of *Sphaerophysa* in America is fairly recent. The first record known to me is that of St. John (*Astragalus violaceus*), based on collections from Yakima County, Washington, in 1928. It was found in northern Arizona in 1936, but has turned up subsequently in most of the arid western states, very likely dispersed (in part) with seed of alfalfa. Because of its tenacious, deep-seated rootstock, the plant is difficult to eradicate, once established, and eventually forms extensive clumps which run together into thicket-like patches.

The generic position of *Sphaerophysa* has been disputed and is far from settled. The typical species, *S. salsula*, was first described as a species of *Phaca*, and its pod is technically in accord with that genus as defined by Linnaeus. DeCandolle distinguished the genus by the pod's relatively firm texture, but this can be matched in several genuine unilocular or "phacoid" *Astragali* now known. Taubert reduced *Sphaerophysa* to a sect. *Asiaticae* of the otherwise Australian genus *Swainsona* R. Br., a barbistyled member of the *Galegeae Coluteinae* supposedly differentiated from the South African *Lessertia* DC. by a more or less inflexed ventral suture in the pod. The majority of genuine *Swainsonae* differ from *Sphaerophysa* by callosities on the banner, but the flower is otherwise similar, with suborbicular (often red) vexillum and wings free from and shorter than the keel. On the other hand *Astragalus complanatus* R. Br. ex Bge. (*Phyllolobium chinense* Fisch. ex Spreng., Nov. Prov. Hort. Acad. 33. 1819), typus of the Asiatic *Astragalus* sect. *Phyllolobium* (Fisch.) Bge., agrees in all important characters with *Sphaerophysa* except that the pod is not inflated. No substantial morphological characters have ever been ascribed to *Lessertia*, *Swainsona*, or *Sphaerophysa* which will separate all their species into African, Australian, and Asiatic genera; even Bentham & Hooker (Gen. Pl. 1: 504. 1865) distinguished them mainly by criteria of dispersal. To this group might be added *Astragalus* sect. *Phyllolobium* and perhaps some other isolated and primitive barbistyled *Astragali* referred by Bunge to the sugenus *Pogonophace*; together they might form a single, large genus set off from *Astragalus* sens. lat. by the absence of bosses on the keel and matching sockets on the wings. However, the question of generic limits in the *Galegeae* is fraught with difficulty and requires cytogenetic and anatomical studies on a world basis before any nomenclatural changes are proposed. It should be noted that *Phyllolobium* Fisch. ex Spreng. (1819) has several years' priority over *Sphaerophysa* DC., so that some change in the nomenclature of *S. salsula* seems inevitable.

APPENDIX III. NOMINA NUDA

The names listed in this section have achieved a spurious vitality from an appearance in indices or important taxonomic works. None has any nomenclatural standing, and they are repeated here only for the sake of completeness, and in the hope, probably vain, they will not need to be printed again.

1. *Astragalus Bakeri* Egglest. ex A. Hell., Cat. N. Amer. Pl. 69. 1898.—This name is merely listed.
2. *Astragalus biflorus* Schwein. ex Gray in Proc. Amer. Acad. 6: 234. 1684, in synonymy of *Oxytropis podocarpa* Gray.
3. *Astragalus coloradensis* Rydb. ex A. Nels. in Coult. & Nels., New Man. 283. 1909, in synonymy of *A. carolinianus*.
4. *Astragalus flagellaris* Engelm. ex Sheld. in Minn. Bot. Stud. 1: 152. 1894, in synonymy of *A. Engelmanni* Sheld.
5. *A. Funstoni* Wight ex Mertie in U. S. Geol. Surv. Bull. 836E. 365. 1932, nomen.
6. *Astragalus leptopus* Bth. ex Gray, Pl. Wright. 2: 43. 1853, sine descr.—A manuscript name found on a spm. from Thomas Coulter's Mexican collection. = *A. guatemalensis* var. *Lozani* Jones (GH).

7. *Astragalus lonchocarpus* var. *cymbocarpus* Gray ex Rydb. in N. Amer. Fl. 24: 313. 1929, in synonymy of *Lonchophaca macra*.
8. *Astragalus mandanensis* Raf., Herb. Raf. 39. 1833, nomen.
9. *Astragalus Nuttallii* Raf., l.c., nomen.
10. *Astragalus orthocarpus* Dougl. ex Gray in Proc. Amer. Acad. 6: 196. 1864, in synonymy of *A. canadensis*; taken from a spm. of var. *canadensis* collected in Saskatchewan by Douglas (K).
11. *Astragalus plattensis* Raf., Herb. Raf. 34. 1833, nomen.
12. *Astragalus rubyi* Green & Morris in Jour. Amer. Soc. Agron. 27: 546, 549, figs. 1, 2. 1935 ("Ruby"), nom. provis. = *Oxytropis riparia* Litv., 1908, a Russian sp. introduced into w. Montana.
13. *Astragalus setosus* Pursh ex Richards., Bot. Append. Frankl. Jour. 746. 1823, in synonymy of *A. melanocarpus* Nutt.

APPENDIX IV. SPECIES EXCLUDED FROM THE GENUS

1. ASTRAGALUS ALBERTINUS (Greene) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on *Aragallus albertinus* Greene (1905) = *Oxytropis campestris* var. *gracilis* (A. Nels.) Barneby (1951).
2. ASTRAGALUS ALBIFLORUS (A. Nels.) Gand. in Bull. Soc. Bot. Fr. 48: xiv. 1901, based on *Aragallus albiflorus* A. Nels. (1899) = *Oxytropis sericea* Nutt. (1838).
3. ASTRAGALUS ALPICOLA (Rydb.) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on *Aragallus alpicola* Rydb. (1900) = *Oxytropis campestris* var. *Cusickii* (Greenm.) Barneby (1951).
4. ASTRAGALUS ARCTICUS (R. Br.) Spreng., Syst. 42: 288. 1827, based on and = *Oxytropis arctica* R. Br.
5. ASTRAGALUS ASTRAGATUS Sessé & Moc., Fl. Mex. 185. 1896.—"Habitat in montibus a Tepalcatepec ad Coahuayanam usque interiectis [Michoacán]."—Described as a tree up to 20 ft. high with terminal racemes.
6. ASTRAGALUS BELLI (Britt.) Tidest. in Proc. Biol. Soc. Wash. 50: 18. 1937, based on *Spiesia Belli* Britt. (1894) = *Oxytropis Belli* (Britt.) Palib (1910).
7. ASTRAGALUS BISONTUM Tidest., l.c. 1937, based on and = *Oxytropis multiceps* T. & G. (1838), non *A. multiceps* Bge. (1869).
8. ASTRAGALUS BISONTUM var. MINOR (Gray) Tidest., l.c., based on *Oxytropis multiceps* var. *minor* Gray (1884) = *O. multiceps* T. & G.
9. ASTRAGALUS BLANKINSHIPPII (A. Nels.) Tidest., l.c., based on *Aragallus Blankinshipii* A. Nels. (1899) = *Oxytropis Lagopus* Nutt. (1834).
10. ASTRAGALUS CORONAMINIS (Fern.) Tidest. in op. cit.: 19. 1937, based on *Oxytropis coronaminis* Fern. (1928) = *O. arctica* R. Br. (1824).
11. ASTRAGALUS DEFLEXUS var. FOLIOLOSUS (Hook.) Tidest., l.c., based on *Oxytropis foliolosa* Hook. (1834) = *Oxytropis deflexa* var. *foliolosa* (Hook.) Barneby (1951).
12. ASTRAGALUS FORMOSUS Sessé & Moc., Pl. Nov. Hisp. 119. 1889—"Habitat in calidis Nouae Hispaniae regionibus."—Described as a shrub up to 5 ft. tall, with glabrous, rhombic pods; apparently not an *Astragalus*.
13. ASTRAGALUS FRUTESCENS Kunth, "Ind. Sem. Hort. Berol. 1845: 12. 1845."—Identified by Rydb., N. Amer. Fl. 24: 189. 1923, as *Brongniartia podalyrioides* H. B. K.
14. ASTRAGALUS GASPENSIS (Fern. & Kels.) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on *Oxytropis gaspensis* Fern. & Kels. (1928) = *O. viscida* Nutt. Non *A. gaspensis* Rouss. (1933).
15. ASTRAGALUS GRAYANUS Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 216. 1941, a legitimate substitute for *Oxytropis monticola* Gray (non *A. monticola* Phil., 1864) = *O. campestris* var. *gracilis* (A. Nels.) Barneby (1951).
16. ASTRAGALUS IOCHROUS Barneby in Leaflet West. Bot. 4: 55. 1944, a taxonomically superfluous substitute for *A. violaceus* St. John, q.v. infra.
17. ASTRAGALUS LAGOPUS (Nutt.) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on and = *Oxytropis Lagopus* Nutt. (1834).
18. ASTRAGALUS LAMBERTII (Pursh) Spreng., Syst. 3: 308. 1826, based on and = *Oxytropis Lambertii* Pursh.
19. ASTRAGALUS LAMBERTII var. BIGELOVII (Gray) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on and = *Oxytropis Lambertii* var. *Bigelovii* Gray (1884).

20. *ASTRAGALUS MAZAMA* (St. John) G. N. Jones in Univ. Wash. Pub. Bot. 7: 175. 1938, based on *Oxytropis Mazama* St. John (1928) = *O. campestris* var. *gracilis* (A. Nels.) Barneby (1951).
21. *ASTRAGALUS MEXICANUS* Sessé & Moc., Pl. Nov. Hisp. 119. 1889.—“Habitat in Sancti Angeli oppido prope Mexicum.”—Described as a shrub up to 8 ft. high, with solitary axillary flowers, supposedly related to *A. ammodytes* Pall., but scarcely of this genus.
22. *ASTRAGALUS MISTASSINICUS* Rouss. in Le Nat. Canad. 71: 6, figs. 1, 2. 1944.—“Québec: Lac Mistassini et îles du centre, 10–17 août 1943 . . . Dutilly & . . . Lepage 11563.”—Not seen. Described from poor specimens lacking fruits and suspected to belong to another genus. The cited figure suggests *Hedysarum*. Cf. Lepage in Le Nat. Canad. 72: 285. 1945.
23. *ASTRAGALUS MUNZII* Wheeler in Leaflet West. Bot. 2: 209. 1939, based on and = *Oxytropis oreophila* Gray (1884).
24. *ASTRAGALUS NIGRESCENS* Pall., Astrag. 65, tab. 53. 1800. “. . . inter Aldanum fl. et orientalem Oceanum legit D. D. Merk.” = *Oxytropis nigrescens* (Pall.) Fisch.
25. *ASTRAGALUS NIGRESCENS* var. *arctobia* (Bge.) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on *Oxytropis arctobia* Bge. (1874) = *O. nigrescens* var. *uniflora* (Hook.) Barneby (1951).
26. *ASTRAGALUS OREOPHILUS* (Gray) Tidest., l.c. 1937, based on and = *Oxytropis oreophila* Gray (1884). Non *A. oreophilus* Reiche (1897), nec Rydb. (1904).
27. *ASTRAGALUS PARRYANUS* Tidest., l.c. 1937, based on and = *Oxytropis Parryi* Gray (1884). Non *A. Parryi* Gray (1862).
28. *ASTRAGALUS PASQUALENSIS* Jones, Contrib. West. Bot. 10: 87. 1902 (“*Pasqualensis*”)—“Santiago Pasqualo, Durango, Mexico, Palmer, No. 398, April to May, 1896.”—Holotypus, POM!—This species is an *Indigofera*, identified by Rydberg (in herb.) as *I. acutifolia* Schlecht.
29. *ASTRAGALUS RECTICARPUS* Wood in Bot. Gaz. 3: 50. 1878.—“Indian Territory [collected in] 1875–7 by Timothy E. Wilcox, M.D., Asst. Surg. U.S.A.”—Recognized by Wood himself, in op. cit. 70. 1878, as a form of *Indigofera leptosepala* Nutt.
30. *ASTRAGALUS RYDBERGIANUS* Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on *Aragalus villosus* Rydb. (1901) = *Oxytropis campestris* var. *gracilis* (A. Nels.) Barneby (1951). Non *Astragalus villosus* Mchx. (1803).
31. *ASTRAGALUS SAXIMONTANUS* (A. Nels.) Tidest. in Tidest. & Kitt., Fl. Ariz. & New Mex. 216. 1941, based on *Oxytropis Lambertii* var. *ochroleuca* A. Nels. (1896) = *O. sericea* Nutt.
32. *ASTRAGALUS SEPTENTRIONALIS* Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on and = *Oxytropis podocarpa* Gray (1864). Non *A. podocarpus* C. A. Mey. (1831).
33. *ASTRAGALUS SPLENDENS* (Dougl.) Tidest. in op. cit.: 18. 1937, based on and = *Oxytropis splendens* Dougl.
34. *ASTRAGALUS SPLENDENS* var. *RICHARDSONII* (Hook.) Tidest., l.c., based on *Oxytropis splendens* var. *Richardsonii* Hook. = *O. splendens* Dougl.
35. *ASTRAGALUS STIPULATUS* Sessé & Moc., Pl. Nov. Hisp. 119. 1889.—“Habitat in Apatzinagam [Michoacán].”—Described as a shrub up to 8 ft. tall, with large, reniform, amplexicaul stipules and terminal racemes of dark purple flowers, these sometimes disposed in pairs; not an *Astragalus*.
36. *ASTRAGALUS TOMAE* Tidest. in Proc. Biol. Soc. Wash. 50: 18. 1937, a legitimate substitute for but = *Oxytropis nana* Nutt. (1838). Non *A. nanus* DC. (1802).
37. *ASTRAGALUS VIOLACEUS* St. John in State Coll. Wash. Res. Stud. 1: 98. 1929.—“WASHINGTON: alkali spot, Sunnyside, Yakima Co., P. A. Ruppert, July 23, 1928, and Aug. 6, 1928 . . .”—Holotypus, collected July 23, WS! paratypes, collected Aug. 6, G, WS! = *Sphaerophysa salsula* (Pall.) DC.—Cf. Append. II.
38. *ASTRAGALUS VISCIDUS* (Nutt.) Tidest. in Proc. Biol. Soc. Wash. 50: 19. 1937, based on and = *Oxytropis viscida* Nutt.
39. *PHACA FLORIDANA* Willd., Sp. Pl. 3: 1252. 1801, based on *Robinia vesicaria* Jacqu., Ic. Rar. 1: tab. 148, & Collectanea 1: 105. 1786.—“Crescit in Florida.” = *Glottidium vesicarium* (Jacqu.) Harper.
40. *PHACA POTOSINA* Rydb. in N. Amer. Fl. 24: 337. 1929.—“Type collected between San Luis Potosi and Tampico, December, 1878, to February, 1879, E. Palmer 1051 . . .”—Holotypus, PH! = *Sutherlandia frutescens* (L.) R. Br., sens. lat., the Mexican plant, an occasional escape from cultivation, keying to *S. frutescens* sens. str. Phillips & Dyer in Rev. Sud-Amer. Bot. 1: 69, sequ. 1934.—Cf. also Rydb. in N. Amer. Fl. 24: 250. 1924 (sub *Colutia frutescens* (L.) Medic.).
41. *PHACA SUBEROSA* Sessé & Moc., Pl. Nov. Hisp. 120. 1889.—“Habitat in calidis Mazatlani montibus.”—Described as a shrub with corky bark and 4-angled, inflated pods; not an *Astragalus*.

APPENDIX V. GENERA EXCLUDED FROM NORTH AMERICA

In his dismemberment of North American *Astragalus* Rydberg referred many of our groups to genera based on European and Asiatic species. A few of these have been mentioned already in the taxonomic portion of the Atlas; the remainder, which do not properly belong in the synonymy of any American section of the genus, are listed below.

1. CYSTIUM Stev. in Bull. Soc. Nat. Mosc. 29^a: 147. 1856—Generitypus: *A. Cicer* L.

Steven first proposed *Cystium* in a provisional way in 1832 (in Bull. Soc. Nat. Mosc. 4: 268; reprinted in Nouv. Mém. Soc. Nat. Mosc. 3: 107. 1834) and there listed *A. physodes* Pall. and *A. Pallasii* Fisch. as members of the genus in addition to *A. Cicer*. In the actual place of publication, however, these supplementary species were omitted from *Cystium* and transferred to a new genus *Xerophyssa*, leaving *A. Cicer* as undisputed generitypus of *Cystium*. Subsequently Bunge (1868, p. 113; 1869, p. 193) took up *Cystium* as a section of *Astragalus* subgen. *Cercidothrix* designed to accommodate *A. physodes* and its near relatives, not *A. Cicer*, and this obviously incorrect decision has been accepted universally. The combination *Astragalus* sect. *Cystium* (Stev.) Bge. belongs in the synonymy of sect. *Hypoglottoidei* and should be replaced in the Old World literature by *ASTRAGALUS* sect. *XEROPHYSSA* (Stev.), comb. nov., based on *Xerophyssa* Stev., op. cit. 1856, p. 150 (typus: *A. physodes* Pall.). The genus *Cystium* was revived by Rydberg in 1906 (in Bull. Torr. Club 32: 659) and adapted to include two varieties of our *A. (Diphyssi) lentiginosus*. The American scope of *Cystium* was finally expanded to embrace thirty-three species (Rydberg, 1929, p. 405, sequ.), and the genus came to be defined simply in terms of a pod at once inflated and fully bilocular. The so-called *Cystia* of North America differ from the original species, *A. Cicer*, in having free stipules and a perfectly sessile, deciduous fruit, and from sect. *Xerophyssa* (= sect. *Cystium* sensu Bge.) in their developed stems and basifixed pubescence. They are not at all closely related to either group.

2. HAMOSA Medic., Vorl. Churph. Phys. Ges. 2: 373. 1787.—Generitypus: *A. hamosus* L.

In discussing *Hamosa* and its application to some North American species of *Astragalus*, Rydberg (1930, p. 231) conceded that the comparatively few Old World species, of which he mentioned by name only *A. hamosus*, represent sections not found in America. In Europe and Asia *A. hamosus* is everywhere accepted as forming (with a few very close kindred) the sect. *Buceras* DC., characterized by an annual root, dolabriform vesture, and connate stipules. In habit of growth and form of the linear, dorsally sulcate, bilocular pod *A. hamosus* superficially resembles some of our annual *Leptocarpi* (e.g. *A. Rattani*), but the differences in the stipules and hair-attachment are fundamental, and the relationship is apparently not really close. In any case *Hamosa* Medic. belongs in the synonymy of *Astragalus* sect. *Buceras* DC.

3. ONIX Medic., Vorl. Churph. Phys. Ges. 2: 374. 1787.—Generitypus: *A. galegiformis* L.

Rydberg (1929, p. 415; 1930, p. 232) expanded the hitherto monotypic genus *Onix* to include the American *A. Mulfordae*, typus of our sect. *Neonix*. The original *Onix*, which belongs in the synonymy of *Astragalus* sect. *Galegiformis* Gontsch., was based on a taxonomically isolated species endemic to the Caucasus. Its pod is technically similar in form to that of the American *A. Mulfordae*, but the plant is altogether different in habit, in free stipules, and in form and proportion of the flowers.

4. TIUM Medic., Vorl. Churph. Phys. Ges. 2: 373. 1787.—Generitypus: *A. sulcatus* L.

The typus of *Tium* was referred by Bunge (1869) to the too inclusive sect. *Hemiphaca*, from which its dolabriform vesture handily excludes it. Gontscharov & Borissova (in Fl. U. R. S. S. 12: 451) have transferred it, probably correctly, to sect. *Craccina* (Stev.) Bge. It is an Asiatic type, with no close American relative. As taken up by Rydberg, *Tium* became a repository for miscellaneous groups of American *Astragali* in which the pod (whether erect or pendulous, stipitate or sessile, deciduous or persistent) is of narrow outline, of firm texture, and partly (but not fully) bilocular. The first three species recognized by Rydberg as *Tia* represented the three sections *Drummondiani*, *Tiopsidei*, and *Bisulcati*, and the thirty-three ultimately listed in the genus (Rydberg, 1929, p. 384, sequ.; 1930, p. 307, sequ.) are dispersed in these pages through twelve widely separated groups.

BIBLIOGRAPHY

(Note: A complete bibliography for *Astragalus* in North America would cover nearly the whole floristic literature of continental United States and Canada. The majority of Floras, as well as many general botanical works and occasional papers which have been consulted during the preparation of the Atlas, are excluded from this list which is confined to three classes of entry: 1) works of primary importance to the taxonomy of *Astragalus*, both of Old and New Worlds; 2) revisions of *Astragalus* or of parts of it in North or South America; 3) books or occasional papers cited more than once in the text of the Atlas (including sources for the chromosome numbers cited in the Synopsis). Papers dealing wholly or partly with North American *Astragalus* which contain only descriptions of new taxa, such as many of Jones's and Rydberg's published in *Contributions to Western Botany* and *Bulletin of the Torrey Club* respectively, as well as my series of fascicles published as *Pugillus Astragalorum*, have been taken up in the synonymy of the species involved and are not introduced again here).

Abrams, Leroy

1944. *Astragalus*, in *Illustrated Flora of the Pacific States* 2, pp. 562–611, figs. 2775–2914.

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1945. *Pugillus Astragalorum* IV: The Section *Diplocystium*. *Leaflet West. Bot.* 4: 65–152, Pl. I–IV.

1947 (Jan). *Pugillus Astragalorum* VI: Notes on Section *Drabellae*. In op. cit. 5: 1–9.

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 convallarius
 crispatus = *miser crispatus*
 decumbens = *miser decumbens*
 diversifolius = *diversifolius*
 hylophilus = *miser hylophilus*
 serotinus = *miser serotinus*
camporum (Homalobus) = *miser decumbens*
CAMPTOPODES — XV, p. 298
camptopus — No. 75, p. 299
campylophyllus = *toanus*
canadensis — No. 188, p. 598
 brevidens — No. 188b, p. 601
 canadensis — No. 188c, p. 603
 carolinianus = *canadensis canadensis*
 longilobus = *canadensis canadensis*
 monticola = *canadensis canadensis*
 Mortoni — No. 188a, p. 600
candelarius = *Purshii tinctus*
 exiguus = *Purshii tinctus*
candicans = *calycosus scaposus*
CANDIDISSIMAE = PRORIFERI
candidissimus = *magdalenae*
CANDOLLIANAE = ARIDI
Candollianus = *Wootoni Candollianus*
canescens (Homalobus) = *spatulatus*
canescens (Phaca) = *trichopodus lonchus*
canonis = *Serenoi*
canovirens = *Coltoni moabensis*
capillipes = *trichopodus trichopodus*
caricinus — No. 349, p. 1111
Carltonii = *miser oblongifolius*
carminis — No. 126, p. 451
CARNOSOCARPUS = SARCOCARPI
carnosus = *crassicaarpus crassicaarpus*
carolinianus = *canadensis canadensis*
caryocarpus = *crassicaarpus crassicaarpus*
Casei — No. 245, p. 788
castaneiformis — No. 220, p. 698
 castaneiformis — No. 220a, p. 699
 consobrinus — No. 220b, p. 700
Castetteri — No. 48, p. 229
catalinensis = *didymocarpus didymocarpus*
cedrosensis = *Nuttallianus cedrosensis*
CENANTRUM = PHACA
ceramicus — No. 89, p. 338
 apus — No. 89b, p. 341
 ceramicus — No. 89c, p. 341
 filifolius — No. 89a, p. 340
 imperfectus = *ceramicus filifolius*
 Jonesii = *ceramicus ceramicus*
 longifolius = *ceramicus filifolius*
cerussatus — No. 274, p. 877
chaetodon = *Spaldingii*
CHAETODONTES — LXXXV, LXXXV
 (i), p. 1101, 1103
Chamaeleuce — No. 221, p. 700
 cicadae = *Chamaeleuce*
 laccoliticus = *Chamaeleuce*
 panguicensis = *argophyllus panguicensis*
chamaemeniscus — No. 153, p. 511
Chandonnetii = *adsurgens robustior*
chapalananus = *esperanzae*
CHARTOCYSTIS = ARIDI
chinensis — cf. Append. II, p. 1158
chloödes — No. 68, p. 286
chloridae = *tephrodes chloridae*
chuckwallae = *nutans*
CIBARII — XL (i), p. 495
cibarius — No. 146, p. 495
cicadae = *Chamaeleuce*
 laccoliticus = *Chamaeleuce*
Cicer — cf. Append. II, p. 1159
CICEROIDEI = HYPOGLOTTOIDEI
cimae — No. 151, p. 505
 cimae — No. 151a, p. 508
 sufflatus — No. 151, p. 508
cinerascens = *tetrapterus*
CIRCUMDATI — LXXIII, p. 975
circumdatus — No. 297, p. 975
Clarianus — No. 330, p. 1052
CLAVOCARPUS = LONCHOCARPI
Clementis = *tenellus*
Clevelandi — No. 342, p. 1096
CNEMIDOPHACOS = OCREATI
coahuilae — No. 332, p. 1056
COAHUILANI — LXXIX (vii), p. 1055
cobrensis — No. 34, p. 189
 cobrensis — No. 34a, p. 190
 Maguirei — No. 34b, p. 192
COCCINEI — LVI (v), p. 667
coccineus — No. 211, p. 668
Collieri = *Robbinsii minor*
COLLINI — XVI, p. 300
collinus — No. 76, p. 301
 californicus = *californicus*
 collinus — No. 76a, p. 302
 Laurentii — No. 76b, p. 303
 subglaber = *curvicarpus subglaber*
coloradensis — cf. Append. III, p. 1164
coloradoënsis (Kentrophyta) = *Kentrophyta*
 coloradoënsis
Coltoni — No. 62, p. 272
 aphyllus = *Coltoni Coltoni*
 Coltoni — No. 62b, p. 275
 foliosus = *Coltoni moabensis*
 moabensis — No. 62a, p. 274
columbianus — No. 201, p. 649
compactus (*Hesperastragalus*) =
 didymocarpus didymocarpus
CONDENSATI = DRABELLAE
confertiflorus = *flavus candicans*
 flaviflorus = *flavus flavus*

Congdoni — No. 120, p. 440
 CONJUNCTI — XLV, p. 549
 conjunctus — No. 169, p. 550
 hoodianus = *hoodianus*
 oxytropidoides = *hoodianus*
 Sheldoni = *Sheldoni*
 consectus = *Purshii tinctus*
 CONTORTUPLICATA — cf. Append. II,
 p. 1160
 contortuplicatus — cf. Append. II, p. 1160
 convallarius — No. 50, p. 245
 convallarius — No. 50a, p. 246
 diversifolius = *diversifolius*
 finitimus — No. 50b, p. 248
 foliolatus = *titanophilus*
 hylophilus = *miser hylophilus*
 scopulorum — No. 50c, p. 248
 xiphoides = *xiphoides*
 Cooperi = *neglectus*
 coriaceus — No. 45, p. 221
 cornutum (Cystium) = *lentiginosus*
 platyphyllidius
coronaminis — cf. Append. IV, p. 1165
 Cottoni — No. 9, p. 142
 Coulteri = *lentiginosus borreganus*
 Fremontii = *lentiginosus Fremontii*
 COULTERIANA = DIPHYSI
 Craigi = *diaphanus*
 Crandallii = *adsurgens robustior*
 crassicaupus — No. 236, p. 753
 Berlandieri — No. 236d, p. 760
 cavus — No. 236c, p. 759
 crassicaupus — No. 236a, p. 756
 pachycarpus = *plattensis*
 Paysoni — No. 236b, p. 758
 trichocalyx — No. 236e, p. 761
 cremnophylax — No. 310, p. 1005
crescenticarpus = *amphioxys amphioxys*
cretacea (Phaca) = *lotiflorus*
 Cronquistii — No. 54, p. 257
 Crotalariae — No. 181, p. 579
 anemophilus = *anemophilus*
 Davidsonii = *Preussii laxiflorus*
 magdalenae = *magdalenae*
 Menziesii = *Nuttallii Nuttallii*
 piscinus = *piscinus*
 virgatus = *Nuttallii virgatus*
 CROTALARIAE = DENSIFOLII
crotalarioides = *oocarpus*
 CTENOPHYLLUM = PECTINATI
curtiflorus = *eucosmus*
curtilobus = *tephrodes brachylobus*
curtipes — No. 253, p. 808
 curvicaupus — No. 77, p. 303
 brachycodon — No. 77b, p. 306
 curvicaupus — No. 77a, p. 305
 subglaber — No. 77c, p. 306
 CUSICKIANI — XIX, XIX (ii), p. 317, 326
 Cusickii (Gray) — No. 86, p. 327
 Cusickii — No. 86a, p. 328
 flexilipes — No. 86b, p. 329
Cusickii (Rydb.) = *eremiticus*
cuspidocarpus = *cibarius*

CYANEI = ARGOPHYLLI
cyaneus — No. 200, p. 647
cymatodes = *accidens Hendersonii*
cymboides — No. 224, p. 709
cyrtoides = *collinus collinus*
 CYSTIELLA — LXXII, p. 973
 CYSTIUM = HYPOGLOTTOIDEI
 CYSTIUM (auct) — cf. Append. V, p. 1167
 Daleae — cf. Append. I, p. 1156
 DANICI = HYPOGLOTTOIDEI
dasyglottis = *agrestis*
datilensis = *humistratus humistratus*
Davidsonii = *Preussii laxiflorus*
davisiana (Hamosa) = *Nuttallianus austrinus*
 Deanei — No. 261, p. 845
 DEBILES = POLARES
debilis — cf. Append. I, p. 1158
decalvans = *bisulcatus bisulcatus*
decumbens = *miser decumbens*
 convallarius = *convallarius*
 crispatus = *miser crispatus*
 decurrens = *miser oblongifolius*
 oblongifolius = *miser oblongifolius*
 serotinus = *miser serotinus*
decurrens (Homalobus) = *miser*
 oblongifolius
deflexus — cf. Append. IV, p. 1165
 foliolosus — cf. Append. IV, p. 1165
demissus = *bisulcatus nevadensis*
 DENSIFOLII — LXVII, LXVII (i),
 p. 799, 801
densifolius = *Nuttallii Nuttallii*
 DERMATOCYSTIS = PREUSSIANI
desereticus — No. 195, p. 634
deserticola = *nutans*
 DESPERATI — LVII, LVII (ii), p. 720, 725
desperatus — No. 231, p. 727
 conspicuous — No. 231b, p. 729
 desperatus — No. 231a, p. 728
 petrophilus = *desperatus desperatus*
deterior — No. 230, p. 724
detritalis — No. 71, p. 291
diaphanus — No. 287, p. 903
 DIDYMOCARPI = MICROLOBIIUM
didymocarpus — No. 360, p. 1133
 daleoides = *didymocarpus didymocarpus*
 didymocarpus — No. 360a, p. 1135
 dispermus — No. 360c, p. 1137
 Milesianus — No. 360b, p. 1137
 obispensis — No. 360d, p. 1138
Diehlii = *flexuosus Diehlii*
 DIHOLCOS = BISULCATI
Diholcos = *bisulcatus bisulcatus*
 DIPHACI — LXXXVII, p. 1121
diphacus — No. 355, p. 1122
 peonis = *diphacus*
 DIPHYSI — LXX, p. 910
diphysus = *lentiginosus diphysus*
 albiflorus = *lentiginosus diphysus*
 latus = *lentiginosus latus*
 DIPLOCYSTIUM = DIPHYSI
 DISPERMUS = MICROLOBIIUM

dispermus = didymocarpus *dispermus*
albus = didymocarpus *dispermus*
obispensis = didymocarpus *obispensis*
dispar (Homalobus) = *tenellus*
distortus — No. 301, p. 985
albiflorus = *distortus distortus*
distortus — No. 301a, p. 986
Engelmanni — No. 301b, p. 987
diurnus = *diaphanus*
divergens = *miser decumbens*
diversifolius — No. 51, p. 249
junceus = *convallarius convallarius*
roborum = *convallarius convallarius*
Dodgianus = *diaphanus*
DOLICHANTHOS = **ASTRAGALUS**
 (sect.)
DOUGLASIANAE = **INFLATI**
Douglasii — No. 258, p. 834
Douglasii — No. 258a, p. 835
glaberrimus — No. 258d, p. 840
megalophysus = *Douglasii Douglasii*
Parishii — No. 258b, p. 838
perstrictus — No. 258c, p. 839
piscinus = *piscinus*
tejonensis = *Douglasii Douglasii*
dorycnoides — cf. Append. I, p. 1157
DRABELLAE — XIII, p. 282
drabelliformis — No. 69, p. 287
drepanolobus = *diaphanus*
aberrans = *misellus misellus*
DRUMMONDIANI — XXXIX, p. 489
Drummondii — No. 145, p. 490
melanocalyx = *Drummondii*
duchesnensis — No. 59, p. 267
dumetorum = *Jaegerianus*

Earlei = *mollissimus Earlei*
Eastwoodae — No. 180, p. 577
Egglestonii — No. 31, p. 183
elatiocarpus = *lotiflorus*
elegans = *eucosmus*
curtiflorus = *eucosmus*
minor = *Robbinsii minor*
Elliottii = *obcordatus*
ELLIPTICA = **PHACA**
Ellisiae = *praelongus Ellisiae*
elongata (Phaca, of Hook.) = *flexuosus*
flexuosus
minor = *flexuosus flexuosus*
elongata (Phaca, of Mart. & Gal.) =
guatemalensis brevidentatus
Elmeri = *Gambelianus*
Emoryanus — No. 323, p. 1036
Emoryanus — No. 323a, p. 1038
terlinguensis — No. 323b, p. 1039
encenadae = *trichopodus lonchus*
endopterus — No. 275, p. 879
Engelmanni = *distortus Engelmanni*
ENSIFORMES — XL (ii), p. 497
ensiformis — No. 147, p. 498
gracilior = *Minthorniae gracilior*
EPIPHRAGMIUM = **HEMIPHRAAGMIUM**
Episcopus — No. 57, p. 264

ERECTOSTRICTI = **ULIGINOSI**
eremicus = *lentiginosus Fremontii*
EREMITICI — XLII (iv), p. 529
eremiticus — No. 163, p. 532
malheurensis = *eremiticus*
spencianus = *eremiticus*
ERIOCARPI (Gray) — LVI (vi), p. 670
ERIOCARPI (Rydb.) = **NEWBERRYANI**
eriocarpus = *Newberryi Newberryi*
ERVOIDEI — XX, XX (i), p. 342, 344
ervoides — No. 124, p. 446
ervoides — No. 124a, p. 448
Maysillesii — No. 124b, p. 448
erythrostachys = *Helleri*
esperanzae — No. 33, p. 188
eucosmus — No. 6, p. 116
albinus = *eucosmus*
caespitosus = *eucosmus*
facinorum = *eucosmus*
leucocarpus = *eucosmus*
minor = *Robbinsii minor*
terrae-novae = *eucosmus*
villosus = *eucosmus*
EUODMUS = **ULIGINOSI**
eurekensis — No. 210, p. 666
exilifolius = *simplicifolius*

falcata (Gynophoraria) = *nutzotinensis*
falcatus — cf. Append. II, p. 1161
falciferus = *nutzotinensis*
fallax = *Hallii fallax*
FAMELICAE = **HALLIANI**
FAMELICUS = **HALLIANI**
famelicus = *Hallii fallax*
fastidiosus = *fastidius*
fastidius — No. 267, p. 857
feensis — No. 204, p. 655
Fendleri = *flexuosus flexuosus*
Fernaldi = *Robbinsii Fernaldi*
Figueroai — cf. Append. I, p. 1157
filifolius = *ceramicus filifolius*
filipes — No. 83, p. 319
inversus = *inversus*
residuus = *filipes*
flagellaris — cf. Append. III, p. 1164
flaviflorus = *flavus flavus*
flavus — No. 104, p. 398
argillosus — No. 104c, p. 401
candicans — No. 104b, p. 401
flavus — No. 104a, p. 399
FLEXUOSI = **SCYTOCARPI**
flexuosus — No. 38, p. 201
albus = *flexuosus flexuosus*
Diehlii — No. 38c, p. 207
elongatus = *flexuosus flexuosus*
Fendleri = *flexuosus flexuosus*
flexuosus — No. 38a, p. 203
Greenei — No. 38b, p. 206
sierrae-blancae = *flexuosus flexuosus*
floribundum (Cystium) = *lentiginosus*
floribundus
foliolosus = *ceramicus ceramicus*
formosus — cf. Append. IV, p. 1165

Forwoodii = aboriginum
wallowensis = aboriginum
franciscanus = Nuttallii virgatus
longulus = Nuttallii virgatus
virgatus = Nuttallii virgatus
franciscuitensis — No. 326, p. 1044
lagunensis = franciscuitensis
Fremontii = lentiginosus Fremontii
eremicus = lentiginosus Fremontii
yuccanus = lentiginosus yuccanus
FRIGIDAE = PHACA
frigida (Phaca) — cf. sect. PHACA
americana = americanus
demissa = umbellatus
frigidus — cf. sect. PHACA
americanus = americanus
dawsonensis = umbellatus
gaspensis = americanus
littoralis = umbellatus
frutescens — cf. Append. IV, p. 1165
fucatus — No. 41, p. 210
funereus — No. 215, p. 686
Funstoni — cf. Append. III, p. 1164
GALEGIFORMES = BISULCATI
galegoides = racemosus racemosus
GAMBELIANI — XC (i), p. 1131
Gambelianus — No. 359, p. 1131
Elmeri = Gambelianus
Garrettii = miser tenuifolius
gaspensis (Rouss.) = americanus
gaspensis (Tidest.) — cf. Append. IV, p. 1165
gaviotus = trichopodus phoxus
GENISTOIDEI — XI, p. 230
Gentryi — No. 315, p. 1016
GEOPRUMNON = SARCOCARPI
Gertrudis = puniceus Gertrudis
Geyeri — No. 283, p. 893
Geyeri — No. 283a, p. 894
triquetrus — No. 283b, p. 895
Gibbsii — No. 78, p. 307
curvicarpus = curvicarpus curvicarpus
falciformis = curvicarpus curvicarpus
GIGANTEI — LX, p. 749
giganteus (Wats.) — No. 235, p. 750
yaquianus = giganteus
giganteus (Sheld) = norvegicus — cf. alpinus
gilensis — No. 308, p. 1003
Gilmani — No. 281, p. 889
gilviflorus — No. 366, p. 1151
glaber = Michauxii
glaberrima (Phaca) = Douglasii glaberrimus
GLABRIUSCULA = HEMIPHRAGMIIUM
glabriusculus = aboriginum
major = aboriginum
spatiosus = aboriginum
GLANDULA = ONOBRYCHOIDEI
GLAREOSI = ERIOCARPI
glareosus = Purshii glareosus
glycyphyllos — cf. Append. II, p. 1161
Goldmani — No. 341, p. 1095
goniatus = agrestis
Goodingii = nothoxys

Gormanii = Williamsii
gracilentus = flexuosus Greenei
exsertus = puniceus puniceus
fallax = Hallii fallax
Greenei = flexuosus Greenei
Hallii = Hallii Hallii
gracilis — No. 44, p. 218
erectus = gracilis
parviflorus = gracilis
grallator = bisulcatus Haydenianus
grandiflorus = coccineus
Grayanus — cf. Append. IV, p. 1165
Grayi — No. 113, p. 427
GREGGIANI — LXXXII, p. 1087
Greggii — No. 338, p. 1088
griseolum (Cystium) = lentiginosus Fremontii
griseopubescens = miser miser
gruinus — No. 262, p. 846
guatemalensis — No. 11, p. 151
brevidentatus — No. 11b, p. 154
guatemalensis — No. 11a, p. 153
Lozani — No. 11c, p. 155
oaxacanus = guatemalensis brevidentatus
GYNOPHORARIA — XXII, p. 375
Gynophoraria = nutzotiniensis
gypsodes — No. 237, p. 762
Halei = canadensis canadensis
HALLIANI — X (v), p. 223
Hallii — No. 46, p. 223
fallax — No. 46b, p. 226
Hallii — No. 46a, p. 225
Hamiltoni — No. 66, p. 280
HAMOSA = BUCERAS, cf. Append. V, p. 1167
Harbisonii — No. 250, p. 798
Harringtonii = Robbinsii Harringtonii
Harrisonii — No. 61, p. 270
Harshbergeri = radicans Harshbergeri
Hartmanii — cf. Append. I, p. 1157
Hartwegi — No. 339, p. 1091
Pringlei = micranthus micranthus
HARTWEGIANAE = MICRANTHI
Harwoodii = insularis Harwoodii
Hasseanus = trichopodus phoxus
Haydenianus = bisulcatus Haydenianus
leiocarpus = bisulcatus bisulcatus
major = bisulcatus bisulcatus
Nelsonii = bisulcatus bisulcatus
nevadensis = bisulcatus nevadensis
haydenioides = bisulcatus bisulcatus
HEDYPHYLLA — cf. A. glycyphyllos
heliophilus = lentiginosus salinus
Helleri — No. 234, p. 748
hemigyris = mohavensis hemigyris
HEMIPHACA — VI, p. 144
HEMIPHRAGMIIUM — V, p. 133
Hendersonii = accidens Hendersonii
Herriotii = aboriginum
HESPERASTRAGALUS = MICROLOBIIUM
HESPERONIX — XLVI, p. 558
hidalgensis — No. 25, p. 174
hidalgensis — No. 25a, p. 175

- protensus* — No. 25b, p. 176
hidalgensis (Hamosa) = Hartwegi
Hintoni — No. 13, p. 156
cofrensis — No. 13b, p. 158
Hintoni — No. 13a, p. 157
Hitchcockii (Homalobus) = miser
 oblongifolius
HOLCOPHACOS = AUSTRORIENTALES
holosericeus = macrodon
HOMALOBUS = ERVOIDEI
hoodianus — No. 170, p. 552
HOOKERIANI = CUSICKIANI
Hookerianus (Dietr.) = ervoides ervoides
Hookerianus (Gray) = Whitneyi Sonneanus
 pinosus = Whitneyi Whitneyi
 siskiyouensis = Whitneyi siskiyouensis
 Whitneyi = Whitneyi Whitneyi
HORNIANI — LXIX (v), p. 905
Hornii — No. 288, p. 906
 bajaensis = Hornii minutiflorus
 Hornii — No. 288a, p. 907
 minutiflorus — No. 288b, p. 909
 tularensis = Hornii Hornii
Hosackiae = humistratus Hosackiae
Howelli — No. 128, p. 453
 aberrans = misellus misellus
Humboldtii = mollissimus irolanus
humilis = Shortianus
humilis (Homalobus) = miser oblongifolius
HUMILLIMI — LXXVIII, LXXVIII (ii), p. 1000, 1003
humillimus — No. 311, p. 1007
HUMISTRATI — XXIV, XXIV (i), p. 382, 383
humistratus — No. 100, p. 383
 crispulus — No. 100f, p. 391
 Hosackiae — No. 100d, p. 389
 humistratus — No. 100a, p. 385
 humivagans — No. 100c, p. 388
 sonorae — No. 100b, p. 387
 tenerrimus — No. 100e, p. 390
humivagans (Batidophaca) = humistratus
 humivagans
hyalinus — No. 368, p. 1154
hylophilus = miser hylophilus
 oblongifolius = miser oblongifolius
HYPOGLOTTOIDEI — LV, p. 617
HYPOGLOTTIDENS =
 HYPOGLOTTOIDEI
HYPOGLOTTIDES = HYPOGLOTTOIDEI
HYPOGLOTTIS = HYPOGLOTTOIDEI
Hypoglottis (auct.) = agrestis
 bracteatus = agrestis
 dasyglottis = agrestis
 polyspermus = agrestis
 robustus = adsurgens robustior
 strigosus = tener tener
HYPOLEUCI — LXXXIV, p. 1099
hypoleucus — No. 344, p. 1100
hypoxylus — No. 320, p. 1028
ibapensis = diversifolius
idriensis = lentiginosus idriensis
idriotorum — No. 265, p. 854
impensus = Kentrophyta elatus
imperfecta (Hamosa) = Nuttallianus
 imperfectus
incurvus = Purshii Purshii
ineptus = lentiginosus ineptus
INFLATI — LXIX, LXIX (i), p. 825, 833
inflexus — No. 218, p. 691
 flocculatus = Purshii tinctus
 glareosus = Purshii glareosus
 leucolobus = leucolobus
 ordensis = Purshii tinctus
 subvestitus = subvestitus
insularis — No. 282, p. 890
 Harwoodii — No. 282c, p. 893
insularis — No. 282a, p. 891
 Pondii = insularis insularis
 quentinus — No. 282b, p. 892
intermedius = tephrodes brachylobus
intonsus = villosus
INVERSI — XIX (i), p. 319
inversus — No. 84, p. 324
INYOENSES — XXXVI, p. 482
inyoensis — No. 142, p. 483
iochrous — cf. Append. IV, p. 1165
IODANTHI = DIPHYSI
iodanthus — No. 290, p. 958
 diaphanoides = iodanthus iodanthus
 iodanthus — No. 290a, p. 961
 vipereus — No. 290b, p. 962
iodopetalus — No. 198, p. 643
irolanus = mollissimus irolanus
JAEGERIANI — XXXVII, p. 484
Jaegerianus — No. 143, p. 485
jaliscensis — No. 20, p. 167
JEJUNI — XXIII, p. 379
jejunus — No. 98, p. 380
jemensis = cyaneus
Jepsoni = bisulcatus nevadensis
Jessiae = Kentrophyta Jessiae
Jesupi = Robbinsii Jesupi
Johannis-Howellii — No. 136, p. 467
JONESIELLA = PACHYPHYLLUS
Jonesii = Purshii lectulus
jucundus = oophorus oophorus
julianus = prorifer
junceus = convallarius convallarius
 attenuatus = convallarius convallarius
 diversifolius = diversifolius
 orthocarpus = diversifolius
junciformis = convallarius convallarius
kaibensis = Episcopus
Kelloggiana (Hamosa) = tener tener
Kelseyi = atropubescens
Kennedvi (Cystium) = lentiginosus Kennedyi
KENTROPHYTA = SUBMONOSPERMI
Kentrophyta — No. 94, p. 357
 coloradoensis — No. 94i, p. 369
 danaus — No. 94b, p. 362
 Douglasii — No. 94d, p. 364

- elatus — No. 94h, p. 367
impensus = *Kentrophyta elatus*
implexus — No. 94a, p. 360
Jessiae — No. 94e, p. 365
Kentrophyta — No. 94c, p. 363
neomexicanus — No. 94g, p. 367
rotundus = *Kentrophyta implexus*
ungulatus — No. 94f, p. 366
viridis = *Kentrophyta Kentrophyta*
kernensis = *lentiginosus kernensis*
charlestonensis = *lentiginosus kernensis*
Knowlesianus (*Cnemidophacos*) = *hoodianus*
KOMAROVIELLA = **ASTRAGALUS**
 (sect.)
labradoricus = *alpinus Brunetianus*
albinus = *alpinus Brunetianus*
occidentalis = *Robbinsii occidentalis*
Robbinsii = *Robbinsii Robbinsii*
lagopinus = *Purshii lagopinus*
Lagopus — cf. Append. IV, p. 1165
lagunensis (*Hamosa*) = *francisquitensis*
Lambertii — cf. Append. IV, p. 1165
Bigelovii — cf. Append. IV, p. 1165
LANCEARIUM — XII (iv) — p. 263
lancearius — No. 58, p. 266
LANOCARPUS = **ERIOCARPI**
lanocarpus = *Purshii glareosus*
lanosissima (*Phaca*) = *pyncostachyus*
lanosissimus
lapponicus = *alpinus alpinus*
latus = *lentiginosus latus*
Laurentii = *collinus Laurentii*
laxiflora (*Phaca*) = *Preussii laxiflorus*
Layneae — No. 232, p. 730
LAYNEANI — LVIII, p. 729
lectulus = *Purshii lectulus*
legionensis — No. 12, p. 155
Leibergi — No. 172, p. 556
Lemmoni — No. 348, p. 1109
LEMMONIANI — LXXXV (iii), p. 1109
lenophylla (*Phaca*) = *Whitneyi lenophyllus*
lenophyllus (*Xylophacos*) = *tephrodes*
brachylobus
LENTIFORMES — LXXXV (iv), p. 1111
lentiformis — No. 350, p. 1113
lentiginosus — No. 289, p. 911
albifolius — No. 289j, p. 927
ambiguus — No. 289y, p. 945
antonius — No. 289i, p. 926
araneosus — No. 289s, p. 938
australis — No. 289u, p. 941
borreganus — No. 289zf, p. 953
caesariatus = *lentiginosus idriensis*
carinatus = *lentiginosus lenophyllus*
charlestonensis = *lentiginosus kernensis*
chartaceus — No. 289r, p. 938
coachellae — No. 289zd, p. 951
cornutus = *lentiginosus platyphyllidius*
Coulteri = *lentiginosus borreganus*
cuspidocarpus = *cibarius*
diaphanus = *diaphanus*
diphysus — No. 289t, p. 939
floribundus — No. 289d, p. 921
Fremontii — No. 289z, p. 945
idriensis — No. 289p, p. 935
ineptus — No. 289f, p. 923
Kennedyi — No. 289za, p. 947
kernensis — No. 289l, p. 929
latus — No. 289o, p. 933
lentiginosus — No. 289a, p. 916
MacDougali = *lentiginosus diphysus*
macrolobus — No. 289e, p. 922
maricopae — No. 289zg, p. 954
micans — No. 289ze, p. 952
mokiacensis = *mokiacensis*
nigricalycis — No. 289zc, p. 949
oropedii — No. 289q, p. 936
palans — No. 289zh, p. 955
platyphyllidius — No. 289m, p. 930
salinus — No. 289c, p. 919
scorpionis — No. 289b, p. 919
semotus — No. 289g, p. 925
sesquimetralis — No. 289k, p. 928
sierrae — No. 289h, p. 925
stramineus — No. 289w, p. 943
tehachapiensis = *lentiginosus idriensis*
toyabensis — No. 289n, p. 932
tremuletorum = *lentiginosus scorpionis*
ursinus — No. 289zi, p. 956
variabilis — No. 289zb, p. 948
vitreus — No. 289x, p. 944
Wilsonii — No. 289zj, p. 957
yuccanus — No. 289v, p. 942
Lepagei = *aboriginum*
leptaleus — No. 4, p. 111
LEPTOCARPI — LXXIX, LXXIX (viii),
 p. 1008, 1057
leptocarpoides = *leptocarpus*
leptocarpus — No. 334, p. 1073
leptophyllus — cf. Append. I, p. 1157
leptopus — cf. Append. III, p. 1164
lerdoensis (*Phaca*) = *sabulorum*
leucocystis = *Purshii glareosus*
leucolobus — No. 213, p. 684
consectus = *Purshii tinctus*
subvestitus = *subvestitus*
LEUCOPHYLLI = **TRICHOPODI**
leucophyllus = *asymmetricus*
leucopsis = *trichopodus lonchus*
asymmetricus = *asymmetricus*
brachypus = *curtipes*
curtipes = *curtipes*
curtus = *curtipes*
fastidius = *fastidius*
leucophyllus = *asymmetricus*
lonchus = *trichopodus lonchus*
limatus = *Crotalariae*
limnocharis — No. 99, p. 381
Lindheimeri — No. 335, p. 1076
bellus = *Lindheimeri*
linearis = *aboriginum*
lingulatus = *simplicifolius*
linifolius — No. 115, p. 431
littoralis = *umbellatus*
loanus — No. 208, p. 661

LONCHOCARPI — XII, XII, (v), p. 252, 271

lonchocarpus — No. 65, p. 278

cymbocarpus — cf. Append. III, p. 1165

LONCHOPHACA = LONCHOCARPI

longifolius = *ceramicus filifolius*

longissimus — No. 30, p. 182

LOTIFLORI — LXXVI, p. 993

lotiflorus — No. 305, p. 994

brachypus = *lotiflorus*

cretaceus = *lotiflorus*

elatiocarpus = *lotiflorus*

nebraskensis = *lotiflorus*

pedunculatus = *lotiflorus*

Reverchoni = *lotiflorus*

Lozani (*Atelophragma*) = *guatemalensis*
Lozani

luisanus = *hypoleucus*

LUTOSI — LXIV, p. 784

lutosus — No. 244, p. 785

Lyalli — No. 347, p. 1107

caricinus = *caricinus*

LYALLIANI — LXXXV (ii), p. 1107

Lyonnetii — No. 16, p. 161

MacDougali = *lentiginosus diphysus*

macer = *lonchocarpus*

MacGregorii = *filipes*

macilentus = *Nuttallianus macilentus*

Macounii = *Robbinsii minor*

macrocarpa (Phaca) = *lonchocarpus*

MACROCARPI = LONCHOCARPI

macrodon — No. 259, p. 841

MACRODONTES = INFLATI

macrolobum (*Cystium*) = *lentiginosus*
macrolobus

MACROSEMA = ONOBRYCHOIDEI

madrensis = *nothoxys*

magdalenae — No. 268, p. 858

magdalenae — No. 268a, p. 861

niveus — No. 268b, p. 861

Peirsonii — No. 268c, p. 862

MALACI — XL, XL (iv), p. 493, 509

malacoides — No. 148, p. 500

malacus — No. 152, p. 509

Layneae = *Layneae*

obfalcatus = *malacus*

malheurensis = *eremiticus*

mancus = *calycosus mancus*

mandanensis — cf. Append. III, p. 1165

marcidus = *mollissimus marcidus*

Marcus-Jonesii = *amphioxys amphioxys*

marianus — No. 194, p. 633

Matthewsii = *mollissimus Matthewsii*

Mazama — cf. Append. IV, p. 1166

Mearnsii (*Jonesiella*) = *praelongus*

praelongus

medius (*Xylophacos*) = *eurekensis*

MEGACARPI — LXIII, p. 770

megacarpus — No. 241, p. 771

caulescens = *oophorus caulescens*

Parryi = *megacarpus*

prodigus = *megacarpus*

megalophysa (Phaca) = *Douglasii Douglasii*

melanocalyx (*Xylophacos*) = *amphioxys*

amphioxys

melanocarpus = *missouriensis missouriensis*

mensanus = *atratus mensanus*

Menziesii = *Nuttallii Nuttallii*

virgatus = *Nuttallii virgatus*

Merrillii = *lentiginosus platyphyllidius*

metanus = *Palmeri*

Mexiae = *Pringlei*

mexicanus (A. DC.) = *crassicaarpus*

Berlandieri

trichocalyx = *crassicaarpus trichocalyx*

mexicanus (S. & M.) — cf. Append. IV, p. 1166

MICHAUXIANI — XLIII, p. 542

Michauxii — No. 167, p. 542

MICRANTHI — LXXXIII, p. 1089

micranthus (Desv.) — No. 32, p. 185

micranthus — No. 32a, p. 186

Seatonii — No. 32b, p. 187

micranthus (Nutt.) = *Nuttallianus*

Nuttallianus

micranthus (*Diholcos*) = *bisulcatus*

bisulcatus

microcarpus (*Homalobus*) = *miser*

oblongifolius

microcymbus — No. 35, p. 192

MICROCYSTEI — XX (ii), p. 355

microcystis — No. 93, p. 355

MICROLOBI — X (iii), p. 218

MICROLOBIUM — XC, XC (ii), p. 1130, 1133

microlobus = *gracilis*

MICROMERII — XXIV (ii), p. 394

micromerius — No. 102, p. 394

MICROPHACOS = MICROLOBI

Microphacos = *gracilis*

miguelensis — No. 249, p. 797

Milesianus (*Hesperastragalus*) =

didymocarpus Milesianus

militaris = *vaccarum*

MINERALES — III, p. 113

minima (*Kentrophyta*) = *Kentrophyta*
implexus

minima (Phaca) = *alpinus alpinus*

minor = *Robbinsii minor*

Minthorniae — No. 149, p. 501

gracilior — No. 149a, p. 502

Minthorniae — No. 149b, p. 503

villosus — No. 149c, p. 503

MISELLI — XXXI, p. 438

misellus — No. 130, p. 456

misellus — No. 130a, p. 457

pauper — No. 130b, p. 458

miser — No. 49, p. 231

crispatus — No. 49h, p. 244

decumbens — No. 49g, p. 242

decurrens = *miser decumbens*

hylophilus — No. 49d, p. 239

miser — No. 49e, p. 240

oblongifolius — No. 49a, p. 234

praeteritus — No. 49f, p. 242

serotinus — No. 49c, p. 237
 tenuifolius — No. 49b, p. 237
miser (of Gray) = *microcystis*
miser (of Rydb.) = *obscurus*
MISERES = **MICROCYSTEI**
miserandus = *Hornii minutiflorus*
MISSOURIENSES — LVI (viii), p. 696
missouriensis — No. 225, p. 711
 amphibolus — No. 225b, p. 715
 cuspidocarpus = *cibarius*
 longipes = *missouriensis missouriensis*
 leucophaeus = *missouriensis*
 missouriensis
 microphyllus = *missouriensis*
 missouriensis
 mimetes — No. 225c, p. 716
 missouriensis — No. 225a, p. 713
mistassinicus — cf. Append. IV, p. 1166
mitophyllum = *ceramicus filifolius*
MOENCOPPENSES — XXV (ii), p. 403
moencoppensis — No. 106, p. 403
mogollonicus = *mollissimus mogollonicus*
MOHAVENSES — LXXIX (iii), p. 1020
mohavensis — No. 318, p. 1023
 hemigyus — No. 318a, p. 1025
 mohavensis — No. 318b, p. 1025
mokiensis — No. 182, p. 580
mollis (Phaca) = *mollissimus irolanus*
mollissima (Phaca) = *Purshii Purshii*
 utahensis = *utahensis*
MOLLISSIMI — LIX, LIX (i), p. 732, 733
mollissimus — No. 233, p. 733
 Bigelovii — No. 233f, p. 742
 Coryi — No. 233b, p. 737
 Earlei — No. 233c, p. 737
 flavus = *mollissimus mollissimus*
 irolanus — No. 233e, p. 740
 marcidus — No. 233g, p. 743
 Matthewsii — No. 233i, p. 745
 mogollonicus — No. 233h, p. 745
 mollissimus — No. 233a, p. 735
 nitens — No. 233d, p. 739
 Thompsonae — No. 233j, p. 746
molybdenus — No. 5, p. 114
MONOENSES — LXXI, p. 964
monoensis — No. 292, p. 965
monophyllidia (Hamosa) = *calycosus*
 monophyllidius
montanus = *Kentrophyta Kentrophyta*
 coloradoensis = *Kentrophyta*
 coloradoensis
 impensus = *Kentrophyta elatus*
 rotundus = *Kentrophyta implexus*
 tegetarius = *Kentrophyta implexus*
 ungulatus = *Kentrophyta unguatus*
montereyensis (Hamosa) = *Emoryanus*
 Emoryanus
monumentalis — No. 229, p. 723
Mortoni = *canadensis Mortoni*
 brevidens = *canadensis brevidens*
 Rydbergii = *canadensis brevidens*
Mulfordae — No. 135, p. 465
multicaulis = *pumbentissimus*

multiflorus = *tenellus*
Munzii — cf. Append. IV, p. 1166
musimonum — No. 223, p. 708
musiniensis — No. 207, p. 660
 newberryoides = *musiniensis*

NATURITENSES — LVII (i), p. 722
naturitensis — No. 228, p. 722
 deterior = *deterior*
nebraskensis = *lotiflorus*
NEGLECTI — LII, p. 592
neglectus — No. 187, p. 593
 Limonia = *neglectus*
Nelsonianus — No. 112, p. 426
NEOMEXICANI — LVI (iii), p. 656
neomexicanus — No. 205, p. 656
NEONIX — XXXIII, p. 464
NEVINIANI — XXXII, p. 461
Nevinii — No. 134, p. 463
 Traskiae = *Traskiae*
NEWBERRYANI — LVI (iv), p. 658
Newberryi — No. 209, p. 663
 Blyae — No. 209b, p. 665
 castoreus = *Newberryi Newberryi*
 eriocarpus = *Newberryi Newberryi*
 funereus = *funereus*
 Newberryi — No. 209a, p. 664
 Wardianus = *ioanus*
 Watsonianus = *Newberryi Newberryi*
nidularius — No. 60, p. 269
nigrescens (Nutt.) = *Gambelianus*
nigrescens (Gray) = *tenellus*
nigrescens (Pall.) — cf. Append. IV, p. 1166
 arctobia — cf. Append. IV, p. 1166
nigricalycis = *lentiginosus nigricalycis*
niquiriciaefolius = *mollissimus irolanus*
nitidus = *adsurgens robustior*
 robustior = *adsurgens robustior*
niveus = *magdalenae niveus*
nothoxys — No. 312, p. 1010
NUDI — XLIV, p. 545
nudisiliquus — No. 217, p. 689
nudus = *Serenoi Serenoi*
nutans — No. 280, p. 886
NUTANTES = **INFLATI**
Nuttallianus (DC.) — No. 333, p. 1059
 acutirostris = *acutirostris*
 austrinus — No. 333f, p. 1067
 canescens = *Nuttallianus austrinus*
 cedrosensis — No. 333h, p. 1071
 enneajugus = *Nuttallianus Nuttallianus*
 imperfectus — No. 333g, p. 1070
 leptocarpoides = *leptocarpus*
 macilentus — No. 333c, p. 1064
 micranthiformis — No. 333b, p. 1063
 Nuttallianus — No. 333a, p. 1062
 piliferus = *nyensis*
 pleianthus — No. 333d, p. 1066
 trichocarpus — No. 333e, p. 1067
 zapatanus — No. 333i, p. 1072
Nuttallianus (Speg.) = *flavus*
Nuttallii (J. T. Howell) — No. 251, p. 801
 Nuttallii — No. 251a, p. 803

virgatus — No. 251b, p. 805
Nuttallii (Raf.) — cf. Append. III, p. 1165
 nuttalinensis — No. 97, p. 378
 nyensis — No. 324, p. 1041
oaxacanum (Atelophragma) = *guatemalensis*
 brevidentatus
obcordatus — No. 303, p. 990
obfalcatus = *malacus*
obispensis (*Hesperastragalus*) =
 didymocarpus obispensis
oblatus = *Serenoi* *Serenoi*
oblongifolius (*Homalobus*) = *miser*
 oblongifolius
 OBSCURI — XLII (vi), p. 539
 obscurus — No. 166, p. 539
occidentalis = *Robbinsii* *occidentalis*
 OCREATI — XXV, XXV (i), p. 397
olympicus = *Cottoni*
oniciformis — No. 131, p. 458
 ONIX — cf. Append. V, p. 1167
 ONOBRYCHIDES = ONOBRYCHOIDEI
 ONOBRYCHIUM = ONOBRYCHOIDEI
 ONOBRYCHOIDEI — LIV, p. 609
 OOCALYCES — XXVIII, p. 419
oocalycis — No. 110, p. 419
 OOCARPI = INFLATI
oocarpus — No. 260, p. 843
 OOPHORI = MEGACARPI
oophorus — No. 242, p. 775
 artipes = *oophorus caulescens*
 caulescens — No. 242d, p. 778
 Clokeyanus — No. 242b, p. 777
 lonchocalyx — No. 242c, p. 778
 oophorus — No. 242a, p. 776
ophiogenes = *Purshii* *ophiogenes*
 ORCUTTIANI — XLII (v), p. 538
Orcuttianus — No. 165, p. 538
 gregorianus = *Orcuttianus*
oreganus — No. 189, p. 608
oreophilus (Rydb.) = *canadensis* *canadensis*
oreophilus (Tidest.) — cf. Append. IV,
 p. 1166
orizabae = *mollissimus* *irolanus*
 irolanus = *mollissimus* *irolanus*
ormsbyense (*Cystium*) = *lentiginosus*
 floribundus
 OROBELLA = OROBOIDEI
 OROBOIDEI — IV, p. 115
oroboides = *norvegicus* (cf. *eucosmus*)
 americanus = *eucosmus*
 OROBOIDEUS = OROBOIDEI
 OROCYSTIUM = PLATYTROPIDES
 OROPHACA — XCH. p. 1150
 ORTHANTHI — LIX (ii), p. 747
orthanthus = *Helleri*
orthocarpus (Dougl.) — cf. Append. III,
 p. 1165
orthocarpus (*Homalobus*) = *diversifolius*
 OSTERHOUTIANI — XXIX (ii), p. 434
Osterhouti — No. 118, p. 434
owyheensis = *atratus* *owyheensis*
 OXYGLOTTIDES = SESAMEI

OXYGLOTTIS = SESAMEI
 OXYPHYSI — LXVII (iii), p. 813
oxyphysus — No. 255, p. 813
oxyrrhynchus — No. 343, p. 1098
 OXYTROPIDOIDES = SCAPOSI
oxytropidoides = *hoodianus*
pachycarpus = *plattensis*
 PACHYPHYLLUS — L, p. 569
 PACHYPODES — XXXVIII, p. 487
pachypus — No. 144, p. 487
 Jaegeri — No. 144b, p. 489
 pachypus — No. 144a, p. 488
pachystachys = *canadensis* *brevidens*
pacificus = *accidens* *Hendersoni*
Painteri = *guatemalensis* *brevidentatus*
palans = *lentiginosus* *palans*
 araneosus = *lentiginosus* *araneosus*
 PALANTIA = DIPHYSI
Palliseri = *miser* *serotinus*
palousensis = *arrectus*
Palmeri — No. 263, p. 849
 Johnstonii = *Palmeri*
 PANAMINTENSES — LXXVII, p. 998
panamintensis — No. 306, p. 999
panguicensis = *argophyllus* *panguicensis*
pardalinus — No. 278, p. 883
pardalotum (*Cystium*) = *lentiginosus*
 variabilis
Parishii = *Douglasii* *Parishii*
 perstrictus = *Douglasii* *perstrictus*
 PARRYANI — LVI (vii), p. 693
Parryanus — cf. Append. IV, p. 1166
Parryi — No. 219, p. 693
 PARVI — LXXIX (iv), p. 1026
parviflora (*Phaca*) = *eucosmus*
parviflorus = *gracilis*
 microlobus = *gracilis*
parvifolia (*Phaca*) = *miser* *decumbens*
parvifolius = *gracilis*
parvus — No. 319, p. 1027
pasqualensis — cf. Append. IV, p. 1166
Pattersoni — No. 185, p. 589
 praelongus = *praelongus* *praelongus*
 procerus = *praelongus* *praelongus*
 PATTERSONIANI — LI (ii), p. 583
pauciflorus (*Hook.*) = *vexilliflexus*
 vexilliflexus
pauciflorus (*Gray*) = *leptaleus*
paucijugus (*Homalobus*) = *miser* *tenuifolius*
pauperculus — No. 328, p. 1048
Paysonii — No. 123, p. 445
Peabodianus = *pubentissimus*
Peckii — No. 137, p. 468
 PECTINATI — XXIX, XXIX (i), p. 422,
 423
pectinatus — No. 111, p. 424
 platyphyllus = *Nelsonianus*
Peirsonii = *niveus* *Peirsonii*
Pelecinus — p. 26
Pennellianus — No. 22, p. 169
peonis = *diphacus*
pephragmenus = *tephrodes* *brachylobus*

Perianus — No. 295, p. 972

perstricta (Phaca) = *Douglasii perstrictus*

pertenus = *Nuttallianus cedrosensis*

pervolutinus = *mollissimus Earlei*

petrophila (Batidophaca) = *desperatus desperatus*

PHACA — I, p. 91

PHACAEFORMES = **HEMIPHACA**

phacinus = *alpinus alpinus*

PHACOMENE = **MEGACARPI**

PHACOPSIS = **PATTERSONIANI**

phoenicis = *tephrodes brachylobus*

PHYSONDRA = **PECTI**

PECTI — XIX (iii), p. 336

pictiformis — No. 39, p. 208

pictus = *ceramicus ceramicus*

angustus = *ceramicus ceramicus*

filifolius = *ceramicus filifolius*

foliolosus = *ceramicus ceramicus*

magnus = *ceramicus ceramicus*

pinonis — No. 55, p. 259

pinosa (Phaca) = *Whitneyi Whitneyi*

piscinus — No. 266, p. 856

PISOPHACA = **SCYTOCARPI**

plattensis (Nutt.) — No. 238, p. 765

tennesseensis = *tennesseensis*

plattensis (Raf.) — cf. Append. III, p. 1165

platycarpus = *racemosus longisetus*

montezumae = *Schmollae*

platyphyllidium (Cystium) = *lentiginosus platyphyllidius*

PLATYTROPIDES — LXXIV, p. 977

platytropis — No. 298, p. 979

playanus = *Wootoni Wootoni*

plumbeus = *molybdenus*

Plummerae (Homalobus) = *Gibbsii*

podocarpa (Phaca) = *sclerocarpus*

PODOCYSTIS = **PHACA**

PODOSCLEROCARPI — XVIII, p. 312

POLARES — XXI, p. 369

polaris — No. 96, p. 374

pomonensis — No. 252, p. 806

Pondii = *insularis insularis*

pontina (Phacomene) = *Beckwithii weiserensis*

PORRECTI — XLVIII, p. 565

porrectus — No. 176, p. 566

potosina (Phaca) — cf. Append. IV, p. 1166

potosinum (Atelophragma) = *hidalgensis hidalgensis*

potosinus — No. 18, p. 165

praelongus — No. 184, p. 584

Ellisiae — No. 184b, p. 588

lonchopus — No. 184c, p. 589

praelongus — No. 184a, p. 586

Preblei = *Bodini*

PREUSSIANI — LI, LI (i), p. 572, 573

Preussii — No. 179, p. 574

arctus = *Preussii Preussii*

Eastwoodae = *Eastwoodae*

latus = *Preussii Preussii*

laxespicus = *Preussii laxiflorus*

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limatus = *Crotalariae*

Preussii — No. 179a, p. 575

sulcatus = *Eastwoodae*

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Pringlei — No. 313, p. 1013

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procumbens = *accumbens*

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prorifer — No. 264, p. 851

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pruniformis = *accidens Hendersoni*

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PTEROPHACOS = **PTEROCARPI**

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Gertrudis — No. 47b, p. 229

puniceus — No. 47a, p. 228

Purpusi — No. 26, p. 176

Purshii — No. 212, p. 671

coccineus = *coccineus*

concinus — No. 212f, p. 682

funereus = *funereus*

gavisus = *Purshii tinctus*

glareosus — No. 212c, p. 678

incurvus = *Purshii Purshii*

interior = *Purshii Purshii*

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lectulus — No. 212g, p. 682

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longilobus = *Purshii tinctus*

ophiogenes — No. 212e, p. 681

ordensis = *Purshii tinctus*

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cicadae = *Chamaeleuce*

laccoliticus = *Chamaeleuce*

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Harshbergeri — No. 17b, p. 165
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ratonensis (Pisophaca) = flexuosus flexuosus
 Rattani — No. 329, p. 1050
Clarianus = Clarianus
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reclinatus = diversifolius
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chloridae = tephrodes chloridae
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reptans = radicans
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Reverchoni = lotiflorus
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borealis = Robbinsii minor
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 Robbinsii — No. 7d, p. 129
Rosei = micranthus micranthus
Rothrockii = praelongus praelongus
rotundata (Kentrophyta) = Kentrophyta
 implexus
rubyi — cf. Append. III, p. 1165
 RUGOCARPUS = MICROLOBI
 Rusbyi — No. 29, p. 180

longissimus = longissimus
Rydbergianus — cf. Append. IV, p. 1166
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Rydbergii = miser oblongifolius
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 scopulorum
salinus = lentiginosus salinus
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 p. 1162
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Seatoni = micranthus Seatonii
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selenaeus = amphioxys amphioxys
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 SERICOLEUCI — XCII, p. 1143
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tridactylus = tridactylus
 SERICOPHYLLUS = ARGOPHYLLI
serotinus = miser serotinus
campestris = convallarius convallarius
Palliseri = miser serotinus
strigosus = miser miser
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 SESAMEI — XCI, p. 1139
 SESQUIFLORAE = HUMISTRATI
 sesquiflorus — No. 101, p. 392
 brevipes = sesquiflorus
sesquimetrale (Cystium) = lentiginosus
 sesquimetralis
setosus — cf. Append. III, p. 1165
 Sheldoni — No. 156, p. 519
Shockleyi = Serenoi Serenoi
 Shortianus — No. 199, p. 645
 brachylobus = tephrodes *brachylobus*
 cyaneus = cyaneus
 minor = amphioxys *amphioxys*
Shearii = Hallii Hallii
 SIBIRICI = ONOBRYCHOIDEI
sierrae = lentiginosus *sierrae*
sierrae-blancæ = flexuosus *flexuosus*
Sileranus = subcinereus
 cariacus = subcinereus
siliceus — No. 309, p. 1004
simplex = spatulatus
 SIMPLICIFOLII = DRABELLAE
simplicifolius — No. 70, p. 289
 caespitosus = spatulatus
 spatulatus = spatulatus
simulans = mollissimus *mollissimus*
sinaloæ — No. 125, p. 450
sinuatus — No. 81, p. 315
siskiyouensis = Whitneyi *siskiyouensis*
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solitarius — No. 73, p. 295
Sonneanus = Whitneyi *Sonneanus*
sonoræ = humistratus *sonoræ*
 tenerrimus = humistratus *tenerrimus*
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Spaldingii — No. 345, p. 1103
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 majusculus — No. 286a, p. 901
 sparsiflorus — No. 286b, p. 902
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spatulatus — No. 67, p. 283
 simplex = spatulatus
 uniflorus = spatulatus
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speirocarpus — No. 82, p. 316
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 falciformis = curvicarpus *curvicarpus*
 SPHAEROPHYSA — cf. Append. II, p. 1162
spicatus = canadensis *brevidentis*
 SPIESIOIDES = CALIFORNICI
splendens — cf. Append. IV, p. 1166
 Richardsonii — cf. Append. IV, p. 1166
Standleyi (Homalobus) = tenellus
stenolobum (Tium) = scopulorum
 STENOPHYLLI = INVERSI
stenophyllus — cf. Append. I, p. 1157
 filipes = filipes
 residuus = filipes

sterilis — No. 88, p. 336
stictocarpus = flexuosus *Greenei*
stipitatus (Homalobus) = tenellus
stipulacea (Batidophaca) = humistratus
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stipularis = naturitensis
stipulatus — cf. Append. IV, p. 1166
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stramineum (Cystium) = lentiginosus
 stramineus
straturensis — No. 127, p. 452
streptopus = acutirostris
striatiflorus — No. 296, p. 973
striatus = adsurgens *robustior*
 Chandonnetii = adsurgens *robustior*
strigosus (Sheld.) = tener *tener*
strigosus (Coul. & Fish.) = miser *miser*
 STRIGULOSI — VII, p. 146
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 brevidentatus
 gracilis = hidalgensis *hidalgensis*
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subcompressus = scopulorum
suberosa (Phaca) — cf. Append. IV, p. 1166
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 SUBMEMBRANACEI = SESAMEI
 SUBMONOSPERMI — XX (iii), p. 357
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subuniflorus = Nuttallianus *austrinus*
subvestitus — No. 214, p. 685
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 Paysoni = crassicaupus *Paysoni*
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sulphureus = adsurgens *robustior*
 pinicola = adsurgens *robustior*
supervacaneus = Bolanderi
suturalis = Newberryi *Newberryi*
sylvaticus = umbraticus
syrticolus = mollissimus *Thompsonæ*

tananaicus = adsurgens *tananaicus*
Tarletonis = agrestis
tegetarioides — No. 103, p. 395
tegetarius = Kentrophyta *implexus*
 danaus = Kentrophyta *danaus*
 elatus = Kentrophyta *elatus*
 implexus = Kentrophyta *implexus*
 Jessiae = Kentrophyta *Jessiae*
 neomexicanus = Kentrophyta
 neomexicanus
 rotundus = Kentrophyta *implexus*
 ungulatus = Kentrophyta *ungulatus*
 viridis = Kentrophyta *Kentrophyta*
tehatchapiensis = lentiginosus *idriensis*
tejonensis = Douglasii *Douglasii*
 TENELLI = ERVOIDEI
tenellus — No. 90, p. 344

- acerbus* = wingatanus
Clementis = tenellus
strigulosus = tenellus
tener — No. 327, p. 1045
Bruceae = pauperculus
rattanoides = tener tener
tener — No. 327a, p. 1047
Titi — No. 327b, p. 1048
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tenerrimus
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Tracyi = Wootoni Wootoni
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Candollianus = Wootoni Candollianus
cerussatus = cerussatus
insularis = insularis
morans = Gilmani
playanus = Wootoni Wootoni
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TRIPHYLLI = OROPHACA
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TRIQUETRI = ARIDI
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tristis = canadensis brevidens
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ungulatus
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Deanei = Deanei
Johnstonii = Palmeri
metanus = Palmeri
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vestitus = anemophilus
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Menziesii = Nuttallii Nuttallii
miguensis = miguensis
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virgineus = sabulonum
virgultulus = agrestis
viridis = Kentrophyta Kentrophyta
elatus = Kentrophyta elatus

impensus = *Kentrophyta elatus*
viscidus — cf. Append. IV, p. 1166
visigothicus = *Bodini*
vulpinum (*Cystium*) = *lentiginosus*
 macrolobus

wallowense (*Atelophragma*) = *aboriginum*
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 Newberryi

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Webberi — No. 174, p. 561

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weiserensis = *Beckwithii weiserensis*

Wetherilli — No. 285, p. 898

Whitedii = *sinuatus*

brachycodon = *curvicarpus brachycodon*

speirocarpoides = *curvicarpus*

curvicarpus

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wingatanus — No. 43, p. 215

Dodgianus = *wingatanus*

Wolfii (*Homalobus*) = *Kentrophyta implexus*

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WOODRUFFIANI — XXX, p. 436

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Candollianus — No. 270b, p. 870

endopterus = *endopterus*

morans = *Gilmani*

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 V, p. 1167

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yaquianus = *giganteus*

yuccanus = *lentiginosus yuccanus*

yukonis = *Bodini*

zacatecana (*Phaca*) = *Wootoni Candollianus*

zacatecanus — No. 19, p. 167

zionis — No. 193, p. 631

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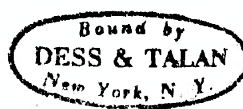
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